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August 1

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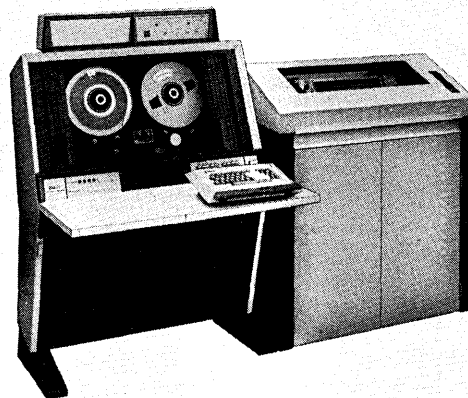


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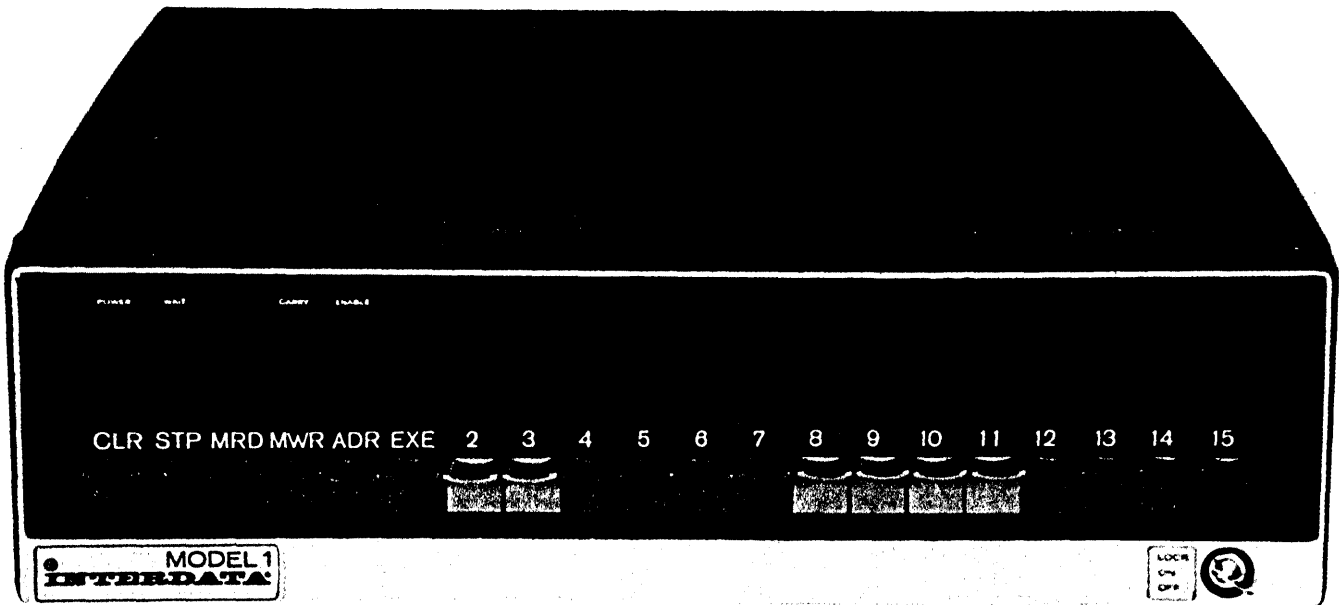
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The Interdata Model 1

DATA⁷¹MATION[®]

AUGUST 1, 1971

volume 17 number 15

T ECHNICAL

24 The Efficient Use of FORTRAN

CHRIS LARSON. It is important that the FORTRAN user become familiar with certain coding techniques which tend to result in fairly good object code regardless of the compiler. This paper addresses itself to FORTRAN optimizations that the user can perform manually at the source code level to improve object code performance.

G ENERAL

34 Job Hunting? You Could Hop the Pond

KENNETH G. BOSOMWORTH. Expanding European computer companies are actively head hunting in the U.S. Here are some important nontechnical considerations for the transatlantic job seeker.

39 Computers in Process Control

ROBERT J. MATHERNE. Sixth annual conference was held this year in Baton Rouge, with the Mardi Gras just 80 miles downstream.

C OMMENTARY

44 Perspective

Small business computers in the System/3 class should experience a sales growth rate of 22% a year during the next five years, says a recent market study report. Latest entry to this business, Management Assistance, Inc., aims to capture up to 3% of the market.

1984 isn't that far away; but we may see the "wired city" long before then, if recommendations of the National Academy of Engineering are followed.

63 The Forum: Cassette Costs and Standards

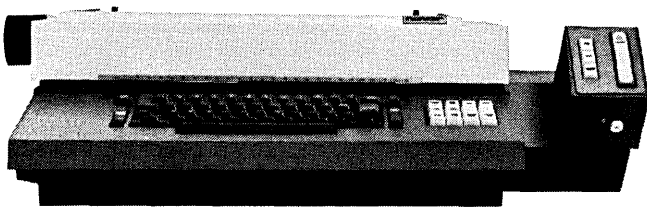
EVELYN BEREZIN. The storage vs. low cost trade-off dilemma must be resolved before industry standardization of cassettes is possible.

About the Cover

The theme article in this issue shows how to get more use from FORTRAN—and our art director extends the idea, showing how to get the most from that simple shape, the triangle.

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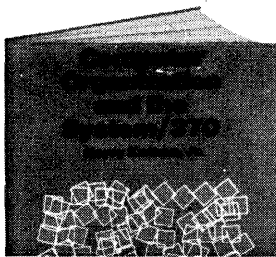
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volume 17 number 15

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EDITORIAL OFFICES

HEADQUARTERS: 94 S. Los Robles Ave., Pasadena, Calif. 91101, Phone: (213) 681-8486; EASTERN: 35 Mason St., Greenwich, Conn. 06830, (203) 661-5400; 19 Marlborough St., Boston, Mass. 02116, (617) 267-9414; 9805 Singleton Dr., Bethesda, Md. 20034, (301) 365-8671; MIDWESTERN: 407 S. Dearborn St., Chicago, Ill. 60605, (312) 922-8245; SOUTHWESTERN: 2711 Cedar Springs, Dallas, Texas 75201, (214) 744-0161. FOREIGN: 65, Hill Road, Chelmsford, Essex, England; 322, Park Regis, Park St., Sydney, NSW 2000, Australia.

GRAPHIC DESIGN AND PRODUCTION

Art & Production Director

Production Manager

Production Assistant

CLEVE MARIE BOUTELL

MARILEE PITMAN

GLORIA J. FASANA

CIRCULATION

35 Mason Street
Greenwich, Conn. 06830

Circulation Manager

Marketing Research Director

MAE VAN RENNES

DOUGLAS DeCARLO

PUBLISHER

GARDNER F. LANDON

ASSOCIATE PUBLISHER

JAMES M. MORRIS

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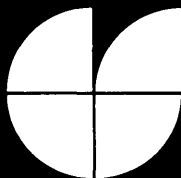
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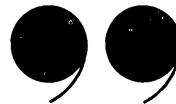


The whole thrust of operating systems until a short time ago has been misdirected in that it has mostly been directed towards doing away with human beings.

Report 1: The Fourth Generation (1971)

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Report 2: Giant Computers (1971)



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Sept. 22-24	IEEE Computer Society Conference	Boston	1971 IEEE Computer Conf. Gen. Del., Kendall Sq. PO Cambridge, MA 02142	\$35, members \$45, others \$2, students
Oct. 17-21	NRMA Annual Information Systems and Telecom- munications Conference	Dallas	NRMA 100 W. 31st St. New York, NY 10001	\$125, members \$175, others
Oct. 25-29	BEMA 1971 Business Equipment Exposition	New York City	Prestige Expositions Inc. 60 E. 42nd St. New York, NY 10007	\$2.50
Oct. 29	ACM 6th Annual Computers and Urban Society Symposium	New York City	Gerald M. Sturman Parsons Brinckerhoff 111 John St. New York, NY 10038	\$28, prereg. \$30, regular \$15, students
Nov. 7-11	American Society for Information Science 34th Annual Meeting	Denver	ASIS 1140 Conn. Ave. NW, 804 Washington, DC 20036	\$45, members \$60, others \$3, students
Nov. 16-18	Fall Joint Computer Conference	Las Vegas	AFIPS 210 Summit Ave. Montvale, NJ 07645	\$20, members \$50, others \$5, students

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CIRCLE 21 ON READER CARD

August 1, 1971

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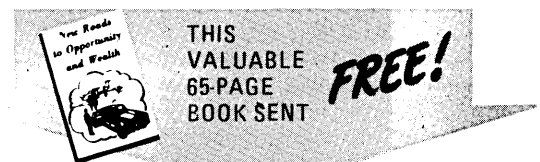
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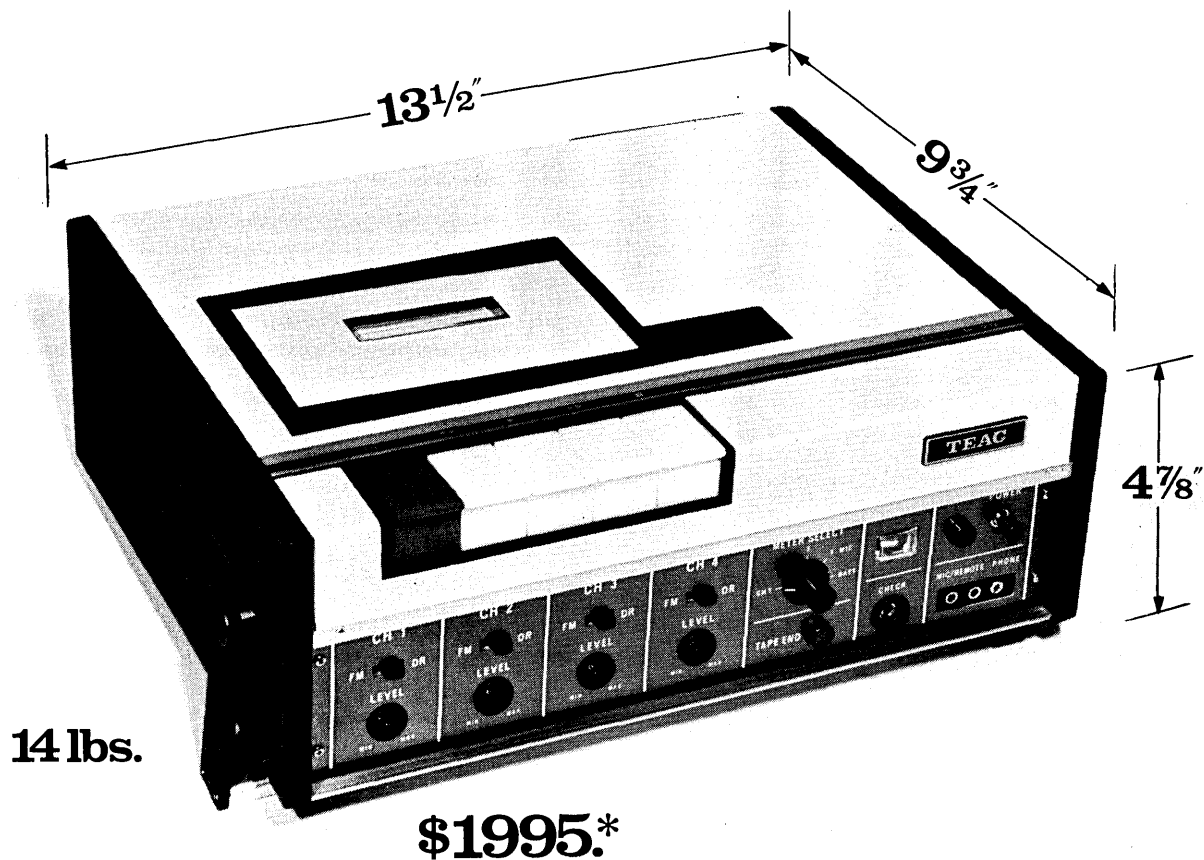
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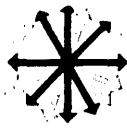
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LETTERS

Power mad

Sir:

It was pleasing that The Forum of the June 1 issue (p. 83) concerned itself with ecology. However, Mr. Ames overlooked the largest source of pollution caused by automation.

Our industry's solution to energy requirements is through the employment of electrical power. The generation of electrical power has traditionally been an ecological problem. Technology's solution to energy requirements has traditionally ignored ecological aspects and effects. The construction of dams, nuclear power plants, and hydro-electric energy sources has had far reaching ecological consequences unforeseen (or ignored) by planners and potential users. I refer you to Gene Marine's treatise, *The Engineering Mentality*, for citations.

Mr. Ames is quite correct in his approach to the problem of the adp industry's consumption of paper goods. Technology long ago provided us with a method of recycling paper. How can we, as the fastest growing business in the world, rectify our consumption of huge amounts of wasted electrical energy daily?

Questions of this sort require concrete, black-and-white answers. We can recycle wasted paper, but how can we "recycle" wasted energy?

MARC H. PERL
Redondo Beach, California

Compaction reaction

Sir:

We read with interest Arnold I. Dumey's comments, "Of Vice and Virtue," in The Forum of the May 15 issue (p. 147) regarding the text compaction technique described in our article, "The Myriad Virtues of Text Compaction" (Dec. 1, 1970, p. 36). Skipping over the enlightening brief on the history of digraphs, Mr. Dumey's main discussion is believed to mislead the reader in two respects.

The first was relegating the programming routine to almost complete insignificance in the comparison to the cryptographical aspects of the technique. While the opposite is certainly not desired, we believe the

overall usefulness of the technique must consider both core consumption and processing time as well as the compression achieved. To suggest that "table look-up would seem to be the way to translate" because "input/output is not the big drain on system time" blatantly discounts the fact that cpu time and core both cost money. The programming routine by being intricately welded to the cryptography thus enhances the overall efficiency of the technique.

The second concerns the point that "the specific method used is not the most efficient, by a non-negligible amount" and suggests that a better selection of digraphs by using a computer analysis can be made. Reiterating the original article, we agree; however, the approach suggested by



Mr. Dumey should be performed somewhat more carefully than described to realize an optimum increase in compression.

1. In proposing that the letters R, S, and V be added to the list of "master" characters (the first of a pair) because they frequently occur in one set of digraphs ignores the cost elsewhere. It is the accumulated pairing with all possible digraphs which must be considered and not just that with one set.

2. When the "space" between words is used as a master character, it can pair with any of 21 combining characters (the second of the pair) and so is not limited to the seven cited as occurring only 41% of the time. The 21 occur 96% of the time.

3. In writing the simple FORTRAN program proposed to tally the frequency of digraph occurrences, someone had better decide whether it's to count each set of two characters in the sentence stream or whether every letter should be paired with both its predecessor and its follower.

In either approach, the result may not be relevant, since a letter once combined under this compression technique is no longer eligible for consolidation with the second possibility, and hence the probabilities are altered.

In conclusion, while there is no doubt that some increase in compression can be achieved through a cryptographical study, it would be important to learn whether the amount inferred by Mr. Dumey is attainable.

MARTIN SNYDERMAN

B. L. HUNT
Washington, D.C.

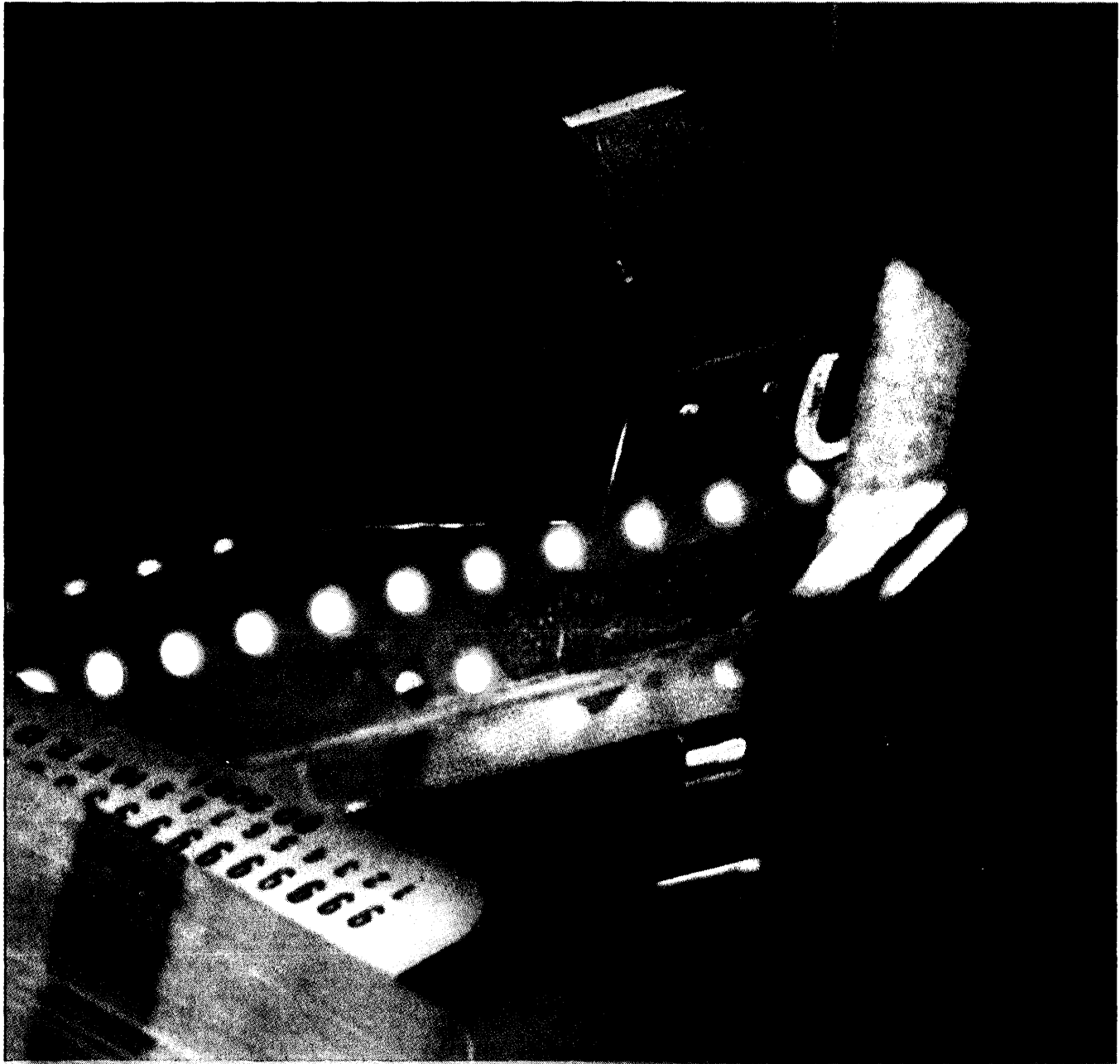
Mr. Dumey replies:

First, I must indulge in the traditional wailing and gnashing of teeth on the subject, "Why didn't they read the article?" The Forum paper expressly negated the idea of a matrix confined to certain initials and certain terminals of digraphs. What was proposed was the use of the 168 (or whatever) most frequent digraphs of the 729 involved. Their comments on word space neglect the quite specific conditions set forth in describing its influence. Of course, the word spacer would be used as part of a digraph, but only with those letters as word initials such as T, S, A, and F, or word terminals like E, T, D, and S, as would qualify for the set chosen for highest frequency.

The concern over computer time is strange. According to the given estimate of 73 usec/character, the total time for processing the file of 200,000 records in question, for example, is about 3.5 hours. Once processed, a record resides on disc for a period governed by archival practices. The core storage for a conversion table would be on the order of 729 8-bit bytes, or 4096 bytes if one chose to avoid the conversion step. On output, a table of 512 bytes would seem to be required. Processing time would be but little longer, I dare say. The relative advantages of saving disc space in the archives over core-computer cost during input/output is left as an exercise for the student.

As far as sampling for frequency is concerned, the result would be the same for either method of tallying digraphs which the authors mention, given sufficient text. The conditional probability of an admissible digraph following another one was something neither article gave attention to. My guess is that this is a second-order effect at best, but it is better to avoid hazy, dizzy, or jazzy conclusions on jejune evidence, as we old digraph counters would say.

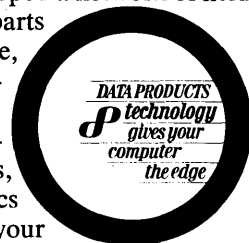
In both papers, it has been implied that the data was being stored for future reference, perhaps for a relatively long time. We see the other side of the coin in a store-and-forward system. Here the emphasis is more on quick processing than on storage efficiency, because both core space and computer time is an object of contention among users. If system analysis reveals a matrix system to be the better method for this application, the extensive literature on clumping and clustering will show how to get a good one.



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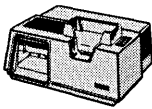


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OEM marketing

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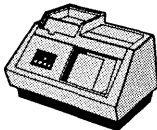
Acton, Massachusetts (617) 263-3961; Bethesda, Maryland (301) 652-8120; Cherry Hill, New Jersey (609) 667-7555; Dallas, Texas (214) 231-2240; Southfield, Michigan (313) 354-5858; Los Altos, California (415) 941-5485; Los Angeles, California (213) 981-9500; Melbourne, Florida (305) 723-0720; Minneapolis, Minnesota (612) 927-8747; Amsterdam, The Netherlands 020-156-297; Tokyo, Japan 493-6451; London, England 01-579-2917; Vienna, Austria 14 51 61 34 44 16

Our complete line of readers. One for every system. All with a quick, sure grasp of the cards...



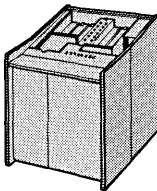
SR 300 Card Reader
—a low cost table-top reader for mini-computers and data terminals. Processes 80-

column and 51-column cards at a demand rate of up to 300 cards per minute. 75 cards per minute versions also available.



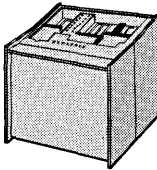
SR 600 Card Reader
—An economical table-top reader for intermediate data processing and data transmission. Equipped with

fiber optics and a single light source for increased reliability. Maintains a demand rate of 600 standard and 750 51-column cards per minute.



SR 800 Card Reader
—A reader for medium-to-high speed card processing, capable of maintaining a reading speed of up to 800 cards per minute. Free

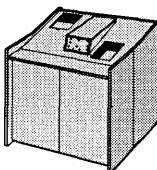
standing, with a hopper capacity of 2500 cards. Reject stacker optionally available.



SR 1500 Card Reader
—One of the finest and fastest card processors in the world, designed for massive workloads. Reads up to 1500 standard cards per minute. Card travel

as well as control logic is checked on each card cycle. Output and reject stackers accommodate up to 2000 cards.

...and a fast, reliable serial card punch that verifies its work.



SP 120 Card Punch
—The most economical card punch on the market! Exclusive serial processing mode enables it to punch data direct from the computer

without code conversion. Punches up to 275 cards per minute asynchronously.



DATA PRODUCTS
OEM marketing

16055 Ventura Blvd., Suite 419
Encino, California 91316

Letters . . .

Lib and let lib

Sir:

The ads of Precision Instrument and Computer Terminal Corp., among others, insult women. A common theme in many of these ads is to show a beautiful girl lying in front of a piece of equipment and then make a joke about her being too dumb to understand anything technical. I think it would be in much better taste if the manufacturers showed a Darkie shuffling in front of a computer saying something like, "This hear computer sho nuff do its stuff."

ROBERT ABBOTT
New York, New York

Snipers

Sir:

Re the letter from Bernard A. McIlhany, Atlanta, Georgia, in the June 1 issue (p. 13), rebellion from our 11th Province is upon us!

Why introduce deliberate errors when the cornerstone, yea, the genesis of our continental history is accuracy. (Ask any United Empire Loyalist about borderline cases.)

Back to your fight against desegregation and other more visible forms of rebellion, Mr. McIlhany, lest we petition Mr. Nixon to restart the Civil War against substitution of wishful thinking for accuracy.

RANDAL H. CAVE
Copper Cliff, Ontario

Payroll pitch

Sir:

The observations made by Jackson W. Granholm in "Parfit Payroll" (April 15, p. 37) were very revealing. How true it is that hastily written payroll programs never get any attention or improvement.

I would like to emphasize two of Mr. Granholm's suggestions. First, a company with the payroll doldrums should use an outside service. Payroll is a system which is really more dynamic than it appears. If a service is strictly a payroll service, then the people will be specialists in that field and be on top of the latest changes and developments affecting payroll. The second suggestion is that a company buy an outside package, install it, and use it.

Most California payroll systems will be in panicsville as soon as the new state income tax withholding

proposal is passed. "Can we squeeze in one more column on that payroll register?" Probably not! Specialists in computer payroll have already made allowance for this future addition.

WILLIAM M. BRUNSKILL
Computer Payroll Company
Garden Grove, California

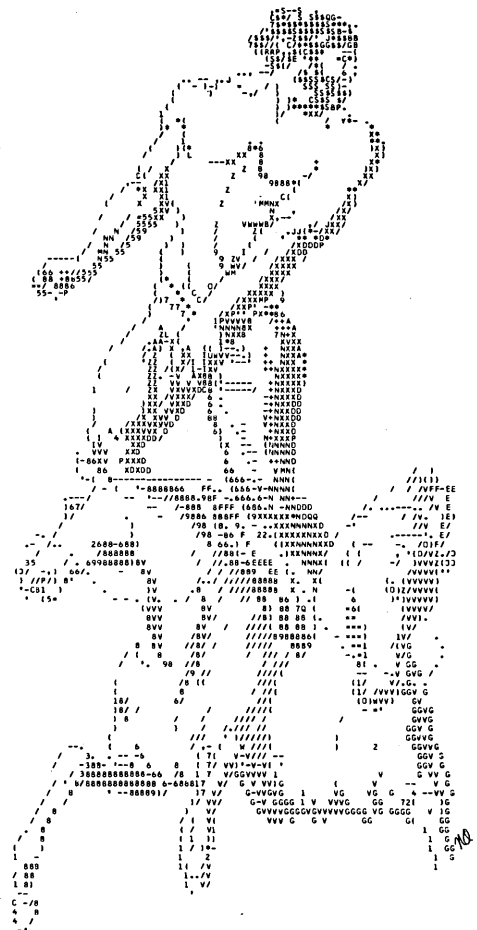
Centerfold

Sir:

Here is a calendar which I made up

```

P P L A V V B B O O V V O F F F T H M H E E V V E E A R N
P L L A A Y B B O O V V O F F F T H M H E E V V E E A R N
  
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JANUARY 1971							FEBRUARY 1971							MARCH 1971						
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OCTOBER 1971							NOVEMBER 1971							DECEMBER 1971						
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29	30	31					28	29	30	31				28	29	30	31			

For people who can't wait 90 days for their next data set.

The 48-hour alternative.

Forty-eight hours. Two days. That's how long it takes to ship an Ultronic data set after receipt of order. Right off the shelf and into your system.

You can have just about any operating capacity you need, too. 300, 1200, 2400, 4800 bps. All operationally compatible with telephone company equipment and EIA Standard RS-232 interface.

Like to hear more? O.K. Let's take them one by one.

The 103/300 Data Pump is an asynchronous frequency shift keying data set that operates in simplex, full-duplex, and half-duplex modes. It transmits over both private and dial network voice-grade lines. Acoustical coupling is built right in.

Our Data Pump Series 202/1200 has something extra built in. Troubleshooting test switches which quickly tell you the source of any data transmission problems. Not that you'll ever have much trouble with an Ultronic 202/1200. It's completely solid state in construction. Transmission of up to 1200 bps is over unconditioned 3002 voice-grade telephone lines.

The Data Pump 201/2400 data set also transmits over 3002 voice-

grade lines. Frequency shift keyed with duo-binary encoding, it has built-in test switches. It works even better than it looks. And that's saying a lot. Because the 201/2400 comes in an attractively designed beige and walnut case that is attractive enough to put on your desk.

No matter how you use it—point-to-point, multipoint, or for remote batch processing—the 203/4800 Data Pump is the workhorse data set with the capacity to do any job. It uses modified duo-binary coding to eliminate the d.c. component in the transmitted signal and compress the bandwidth, so more power is concentrated in the effective part of the spectrum. Short turn-around time provides efficient multipoint operation. Which means you can transmit error-free data and do it faster. Transmission is over standard Series 3002 lines with C2 conditioning. Operation can be two wire in simplex or half-duplex and four wire for half-duplex or full-duplex.

That's what we've got. In standard cabinets or in custom designed card modules in OEM quantities. And you can have any of them on lease—or own them outright.

You also get another benefit. Our own service organization. Some 250 technical experts in 56 cities all across the country. If something goes wrong, you won't have to go very far to get help.

We have everything you want in data sets. The same goes for the rest of your telecommunication needs. Time Division and Frequency Division Multiplexers, video and hard-copy terminals, plus the experience to put them together in a complete system.

Ask us. You won't have to wait around for an answer. Call Lee Shrout, Director of Marketing at (609) 235-7300. Or, write to Ultronic Systems Corp., Department DA-8, Box 315, Moorestown, New Jersey 08057.

I can't wait! Send me ____ of Model _____ data sets right away!

I'm in a hurry, but I can wait a few days until your sales representative calls.

No rush. Send me literature.

Name _____

Position _____

Company _____

Address _____

City _____ State _____ Zip _____

Ultronic Data Sets

GTE INFORMATION SYSTEMS

Letters . . .

for gals. It's printed in both 8 and 6 lines/inch on an IBM 1800.

NANCY ANNE STORCH
Livermore, California

New heights in humor

Sir:

Count me in favor of "Higher Him" (Letters, March 15) and against Mr. Chamberlin's objections (Letters, May 15). "Higher Him" is an ethnic joke, but it is neither sick nor in really poor taste. An ability to joke about our society's ills is a step toward a cure, and "Higher Him" is the funniest thing I've read in months. It is significant to note that the object's surname is *not* Spanish.

JOHN P. AURELIUS
New York, New York

In whose defense?

Sir:

In answer to the separate letters of William A. Bocchino and Robert Glass in your June 1 issue, I would like to point out a couple of reasons why computer professionals should oppose the ABM system.

First, in answer to Mr. Bocchino, faith is not a reason to support a system when evidence is available that it will not work. Published studies on the ABM system indicate that the hardware required for the system would equal all the combined commercial and military computers presently installed; and that the software (secondary level) will probably fail to properly direct ABMS to their target once the first atmospheric blasts occur, ionizing the atmosphere and rendering targeting radar useless. Moreover, due to a probably larger number of warheads (remember MRV and MIRV?) than ABMS, a (primary level) priority program requires development. Given the probable paucity of information under actual conditions and the politics of priorities, most experts concede that this

DATAMATION welcomes correspondence about the computer industry and its effects on society, as well as comments on the contents of this publication. Letters should be typed, double-spaced, and brief. We reserve the right to edit or select excerpts from letters submitted to us.

program cannot be written.

Second, in reply to Mr. Glass, what is the value of a defensive system which, if successfully deployed, would only guarantee that the "victor" nation sees the last generation of human life? Studies by Dr. Ernest Sternglass (Univ. of Pittsburgh, radiation physics) and independently in Sweden and Japan show that the amounts of strontium-90 created by either a successful ABM deployment or first-strike (strontium-90 has a half

life of 45 years) would be sufficient to be fatal to most children and all fetal life.

In conclusion, I would like to state that everyone, professional and worker alike, should oppose the development of the ABM system. For myself, I will oppose it, and whenever possible, work against it. I place life above this military-industrial madness.

DAN TANNER
Indian Mills, New Jersey

ACTION\APL 370!

ACTION\APL, the only commercially available and user proven APL system now on fourth generation equipment.

ACTION\APL. If you're already an APL user, you'll recognize **ACTION\APL's** unmatched versatility. **New fast formatting.** All kinds of plotting. Business packages. Scientific packages. COGO. CPM. COM. LP. CRT. Accounts payable. Circuit analysis. And more! Join the swing to **ACTION\APL.** Chances are it's locally available in your city.

SYSTEM/370. **ACTION\APL's** new fourth generation equipment is **four times faster than conventional systems!** Yet its reliability is greater than ever.

48K WS. The standard APL workspace is 32K. **ACTION\APL's** 48K workspace gets 50% more work done. 50% more data can be stored. And 50% larger programs can be executed without that tiresome old)SAVE)LOAD)COPY routine.

FILES. If you need more than a 48K workspace, we have files storing 144K each. As many as you want. Sequential, direct and keyed access methods are supported, all through easy to use functions which may be embedded within other functions. **You can put the data on the file yourself from your terminal, or send it to us for loading. From disk, tape, cards or whatever. And the files are buffered for super high velocity performance.**

RJE. If that 150 wpm printer gets you down, **ACTION\APL's** exclusive RJE is the answer. Reports and cards can be generated at high speeds. Standard and upper-lower print trains are available. RJE also supports compilation of other languages. . .Assembler, COBOL, FORTRAN, PL/1 and RPG.

CHECK THE ADVANTAGES OF ACTION\APL. It's been in use for over two years, and it's getting better all the time. **ACTION\APL** has the largest commercially available public library system. **ACTION\APL** offered the first commercially available file system. **ACTION\APL** offers the only RJE system. **ACTION\APL** is the only commercially available system on fourth generation equipment. It works with key driven terminals, paper tape terminals, punched card terminals, CRT terminals, COM terminals, graphic plotting terminals. . .in fact, all kinds of terminals. And **ACTION\APL** software is available for in-house installations.

ACTION\APL is now available in Boston, New York, Trenton, Miami, Richmond, Philadelphia and Washington.

For your user number, call or write:

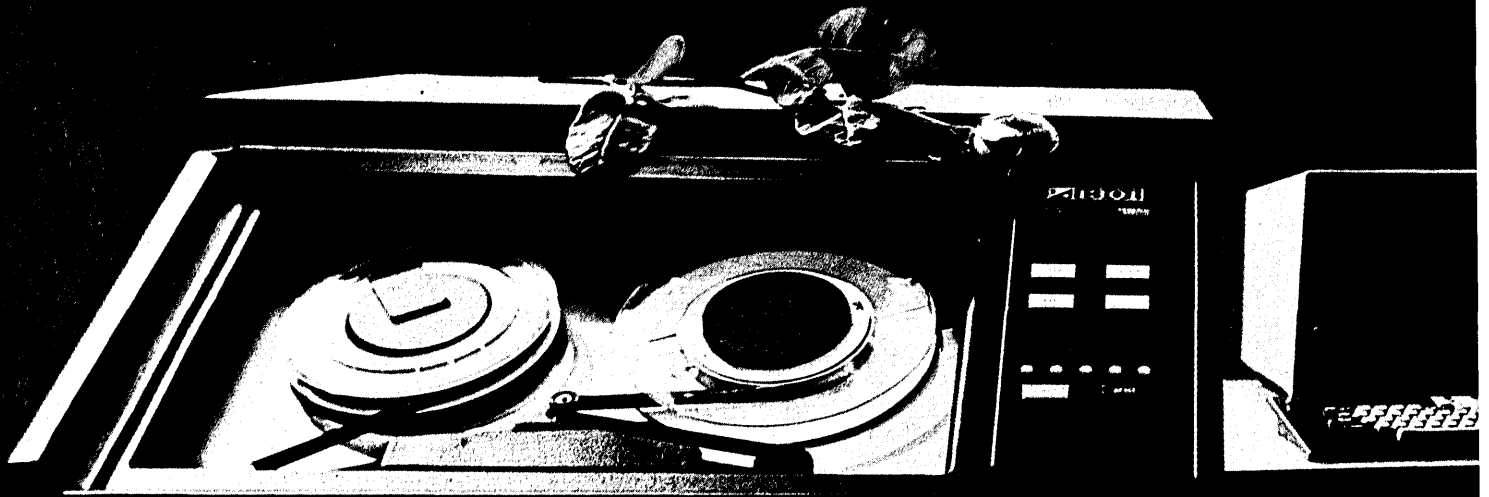
Joel Lamb, APL Services, Inc.
865 Lower Ferry Rd., Trenton, N.J. 08628
(609) 883-0050. . .or,



THE COMPUTER COMPANY

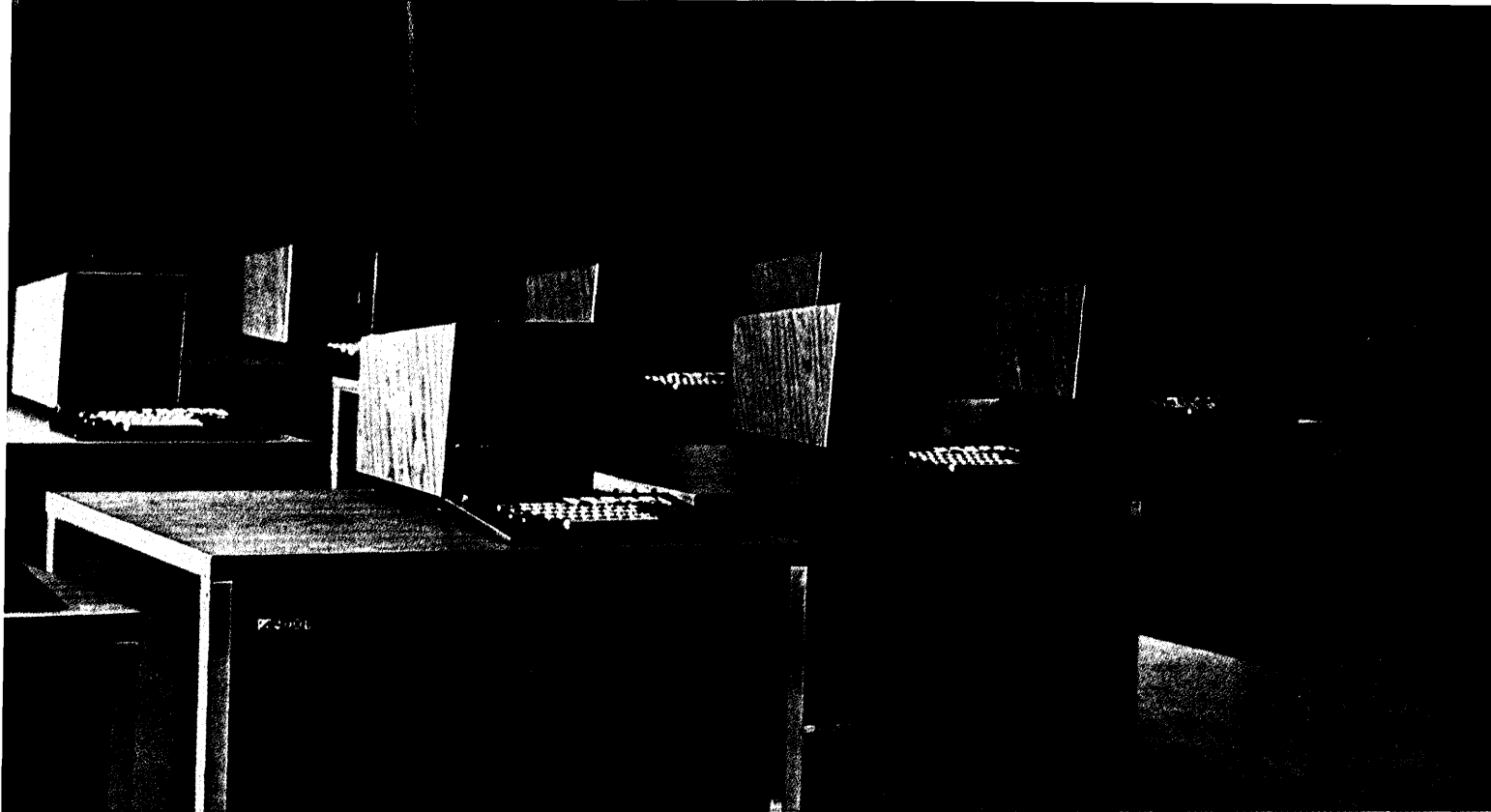
SEVENTH AND FRANKLIN BUILDING, RICHMOND, VA. 23219, (703) 648-5823

CIRCLE 34 ON READER CARD



**INFOREX shared processor system
gives you 8 Keystations
for \$120 a month per Keystation**





SEARCH, MODIFY, TRANSFER, VERIFY TAPED DATA . . . \$80 a month/System
Tape Search lets you retrieve any file or record, from any Keystation, and display it at the Keystation.

COMMUNICATE BETWEEN SYSTEMS... \$80 a month/System Transfer data over a switched network, using standard 201A-rated modems in a "dial-up" environment, or via leased lines, with

PLAN FOR FUTURE GROWTH WITH 1600 BPI TAPE . . . \$100 a month/System
Model 1301 Control Unit is available with a 1600 BPI Phase Encoded Tape Drive (556 and 800 BPI densities

...and you can add any of these extra capabilities as you need them

Tape Update In Place lets you change, add to or delete records on tape without transferring them to System's disc.

Tape-to-Disc Transfer allows file division, logical record batching, adding and modifying records—from any Keystation—concurrent with normal operation.

Blocking and Unblocking gives faster, lower-cost data transfer, better utilization of your computer, with full flexibility at time of data transfer.

Program Control Transfer permits taping sets of program control formats at convenient times, then quickly reading them into the System when needed without re-keying.

Tape Proofing affords high-speed verification of the completeness and computer-acceptability of taped data, plus a display of completed record count.

both sending and receiving Systems fully operational or the sending System unattended.

PRINT HARD COPY OF SELECTED FILES . . . \$373 a month Impact Printer has 132 print positions, 200 line/min. speed, can be shared by as many as four Systems. Capabilities include line advancing, page skipping, stored page headings, data reformatting, edit word insertion, selected field printing, multiple line print from one record, printing from computer-generated tape, floating dollar sign, etc.

CONTROL UP TO FOUR SYSTEMS (31 operators) . . . \$120/month for the first two Systems, \$40/month each additional
Using any Keystation of connected Systems, a supervisor can monitor operator activity, initiate data transfers, collect files from multiple Systems into a single output tape. Control Units can intermix tape drive densities for maximum tape processing flexibility.

standard for 7-track, 800 BPI on 9-track Drives). Permits faster read-in rates, greater reliability.

EVALUATE THE INTELLIGENT KEY ENTRY SYSTEM for your operation. System leases for \$50 per keystation and \$560 for Control Unit, including maintenance. Full 125-character record display. Key and visual data verification at any station. Disc memory stores 128 program control formats. Functions include automatic pooling on 7- or 9-track computer compatible tape, balance totalling, generating and comparing check digits. Write for full information. We would be pleased to have you check with present users on System performance, supported by our international field engineering staff. INFOREX, Inc., 21 North Avenue, Burlington, Mass. 01803 or Inforex AG, Birsigstrasse 4, 4000 Basel, Switzerland.



Phooey on ISAM...!

You'd be mad too if you were in the same position I was. For the last four years I was using ISAM as my file accessing technique, . . . never realizing how much it was costing.

Then along came this guy from COMRESS with a "plug-to-plug compatible" replacement for ISAM called AMIGOS. He told me I could reduce my run time by 30%, reduce core by 20%, and use less room on my direct access devices if I changed from ISAM to AMIGOS.

"Sure", I said, "I've heard those claims before."

But he guaranteed it!

If I didn't get these minimum reductions just return the program at no cost.

So I signed. Tried it and guess what . . .

My average savings was 60% on time.

25% on core, and,

20% on disc space.

Now I've got more computer time available than I ever thought possible . . . Make's my job a lot easier, . . . and to think I was going to get a bigger computer because of ISAM . . . Phooey on ISAM.

I wonder what COMRESS will come up with next?

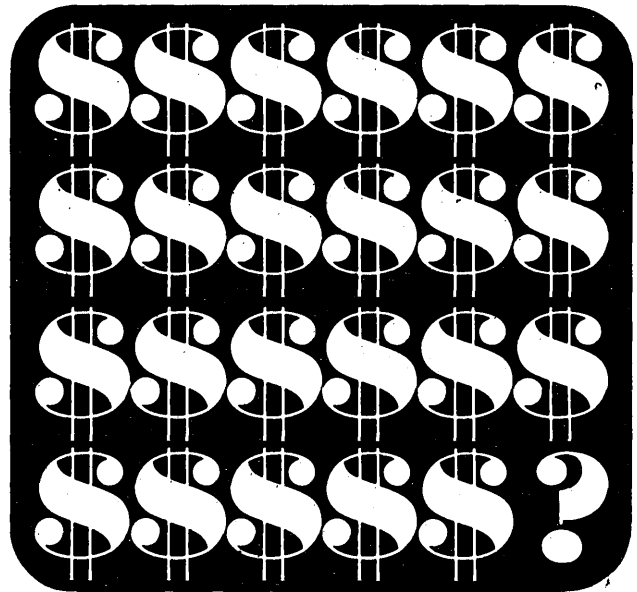
ARE YOU CHARGING TOO MUCH FOR COMPUTER SERVICE? OR NOT ENOUGH?

When you provide EDP service to a number of departments, how can you distribute costs fairly and accurately? Especially when the costs and usage of the computer vary from month to month? Good question.

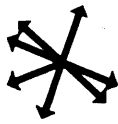
Burroughs has the answer. It's called EDP-TABS, a Time Analysis and Billing System that lets you distribute the total costs of your EDP operation to the penny. TABS analyzes every job that's run, then bills each department for the exact amount of processor, memory and peripheral use. TABS reports on total system performance, too. Its detailed analyses point your way to improving service and minimizing costs.

EDP-TABS is designed for the B 2500, B 3500 and B 4500 systems . . . the hard-working family of low- to medium-priced computers from Burroughs.

For more information, ask your Burroughs representative for a copy of our EDP-TABS brochure. Or write to us in Detroit, 48232.



Burroughs 



SEYMOUR CRAY
THINKING BIGGER

"After the 7600, I'm not going to work on any more small machines," is a line attributed to Control Data's resident genius Seymour Cray. Cray is rumored to be working on a machine with 15 to 20 times the power of a 7600 -- and using transistors. No one is sure what CDC plans to propose to the Atomic Energy Commission, which is looking for supercomputers and is willing to accept bids of unannounced machines. Some are guessing, by the way, that IBM announced its 370/195 two years ahead of delivery just to be on the safe side in bidding to the AEC.

CAMPUS-TO-MARKETPLACE
-TO-CAMPUS

Berkeley Computer Corp.'s big Model 500 time-sharing machine, idle since the company closed its doors in May, was expected to find a new home this month on a university campus where it would be used for a year or so as a research vehicle for computer science students and then would become the basis for a university time-sharing system. Dr. Melvin Pirtle, president of the defunct company, said it was, at this writing, negotiating with "several universities" and expected to consummate a sale to one "within a few weeks." He said use of the machine, which can handle up to 20,000 remote terminals, as a research vehicle is appropriate since "the big interest always has been in its architecture." So the time-sharing computer, born of ideas developed on a campus when Dr. Pirtle was working on the ARPA-funded Genie project at the Univ. of California, probably is again campus bound.

ITEL FINDS WAY AROUND
370 LEASE ENTICEMENTS

ITEL Corp. has come up with a marketing strategy to stave off long-term leases of IBM 3330s. If a user will get a 3330 on month-to-month rental and sign a letter of intent for the ITEL-compatible version, ITEL will pay the difference between IBM rental and lease charges until it can deliver a replacement. ITEL figures its deliveries will begin by the end of '72.

CENTURY TO GET IBM
3330 IN OCTOBER

Although it was among the first to order a 3330, Century Data Systems said it's been told by IBM not to expect to have it before Oct. 8, two months behind IBM's schedule for first deliveries. Meanwhile Century, which displayed a 3330 prototype in May and hopes to have an IBM-compatible drive by mid-1972, still does a flourishing business with its first product -- the CD 111. That's the replacement for IBM's 2311 which the CalComp subsidiary introduced in 1969 when it still was a 20-man organization. Today, at its 288,000-sq.-ft. plant in Anaheim where there are 800 people, the 111 still accounts for 20% of the firm's output, which this year is estimated by trade sources at more than \$40 million. Most 111 sales are in Europe, says president George Canova.

MEMORY FIRMS ADDING
370s TO MARKET PLANS

IBM's 370 computers, as well as its 360s, are in the plans of two California companies who this summer entered the core memory replacement and extension market. Electronic Memories of Hawthorne formed a Computer Products division to assemble and sell extensions to IBM's 360/30, 40, 50, and 65 line and announced it will have 370 add-ons in the first quarter of next year. It said it has one customer installation -- on a mod 40 in Los Angeles -- but won't identify the customer.

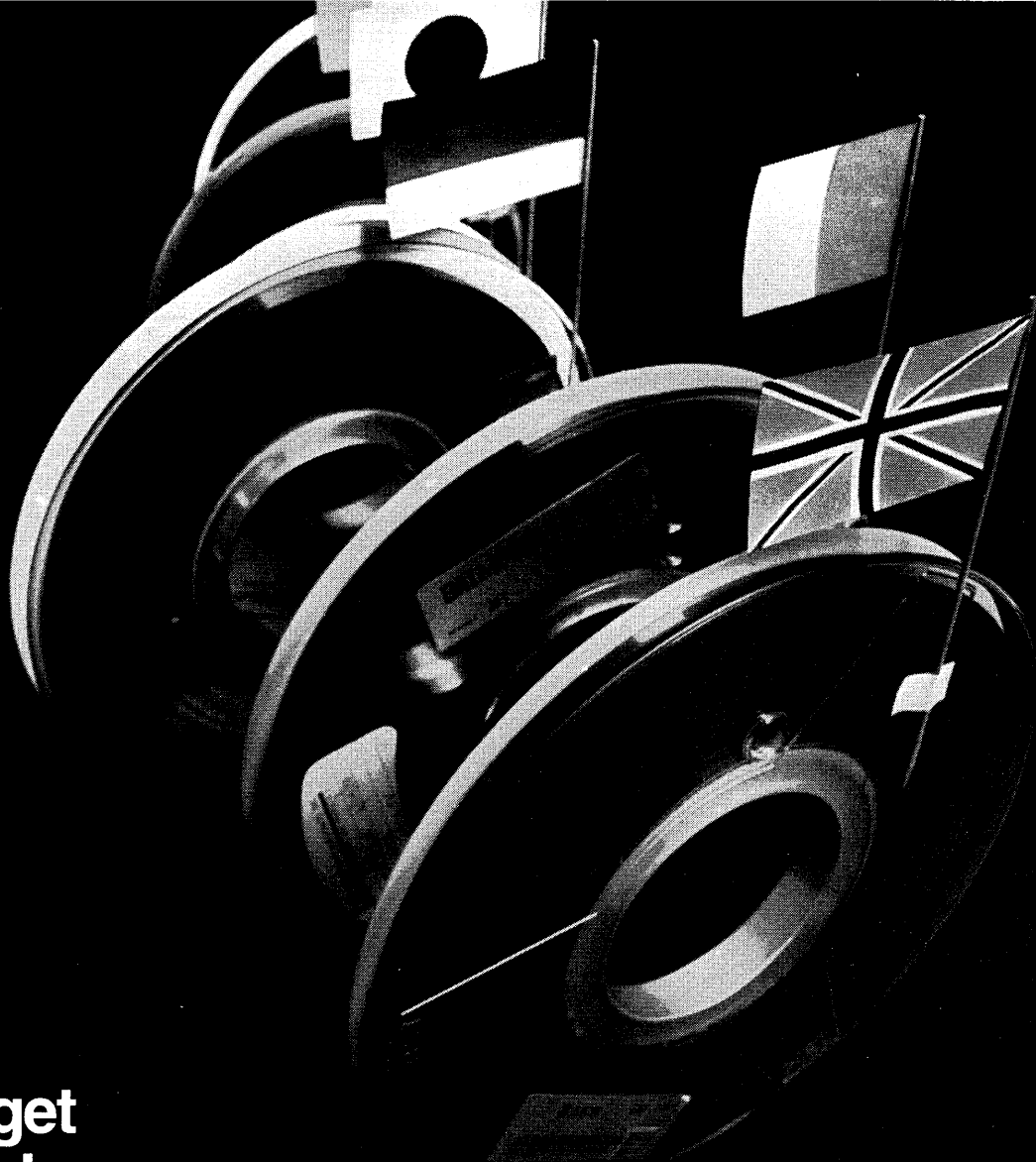
First product of the other entrant, Standard Memories, Inc., of Santa Ana, is a 360/40 memory add-on to be built some time this month, with mod 30 and 50 boxes to follow in September and October. Standard's computer peripherals marketing manager, Dilip Parikh, says the company will announce a 370/155 and 165 memory unit soon. He added that the 370 memory replacement market will "flourish" in 1973 and "be great" in 1975. Standard, meanwhile, has moved its corporate offices across the country to Ft. Lauderdale, Fla., so its president J.F. Flood and Parikh can be closer to its core-stringing and memory-assembly facilities in Barbados and San Juan.

OF SHOES AND SHIPS
AND SEALING WAX...

Development of a higher level language for Illiac IV has been termed a formidable challenge because the architecture of the big machine is so different from that of a conventional computer. One under development now has been optimistically given the name of something which successfully met a challenge according to Norse mythology. It's Gleipner, named for a shackle or fetter made by a dwarf for Norse gods to constrain a wolf who had broken the strongest of chains. The original Gleipner was soft and smooth as silk, yet strong and tough, and was made from the noise of a cat's footfall, the beard of a woman, the roots of a mountain, the nerves of a bear, a fish's breath, and the spittle of a bird. Whatever is going into Illiac's Gleipner, it is described as ALGOL-like and it is hoped it won't fetter those who use it.

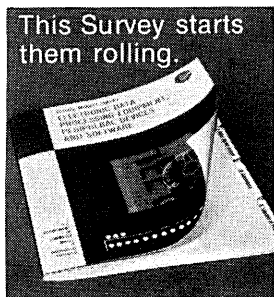
RUMORS AND
RAW RANDOM DATA

We hear a firm asked for bids on a full payout 370 lease and received more than a dozen proposals with discounts ranging from 20-40%. Based on that faith in 370 longevity, the firm opted to buy...Everyone keeps saying the IBM 370/145R (for relocation) announcement is imminent. Supposedly the machine is running at IBM's Cambridge, Mass., plant with the cp/cms operating system developed for the 360/67...Cambridge Memories has installed two memory units at systems owned by IBM, and additional similar deals may be in the offing... Emulation of IBM 360s is a big feature on the computer being built by Memorex' subsidiary, Midwest Systems Corp...The U.S. patent office has established class No. 444/1 for computer programs...An RCA salesman on the IBM price cuts: "We used to tell prospects we could do everything IBM does, but at lower cost; now we have to tell them we can do everything IBM does, but at higher cost!"



**We can get
the wheels
turning**

**to get you a piece of the
\$4 billion EDP market overseas.**



abroad for American EDP hardware, software, peripheral equipment.

A special market study—more than a year in the making—tells the whole story. It has been specially prepared by the U.S. Department of Commerce's Bureau of International Commerce for the computer industry as part of the Global Marketing Program.

It can tell you who's looking to buy what

When it comes to EDP equipment America is the world leader. Yet the time has never been better to cultivate new markets than right now. Just look overseas!

Potential customers abound

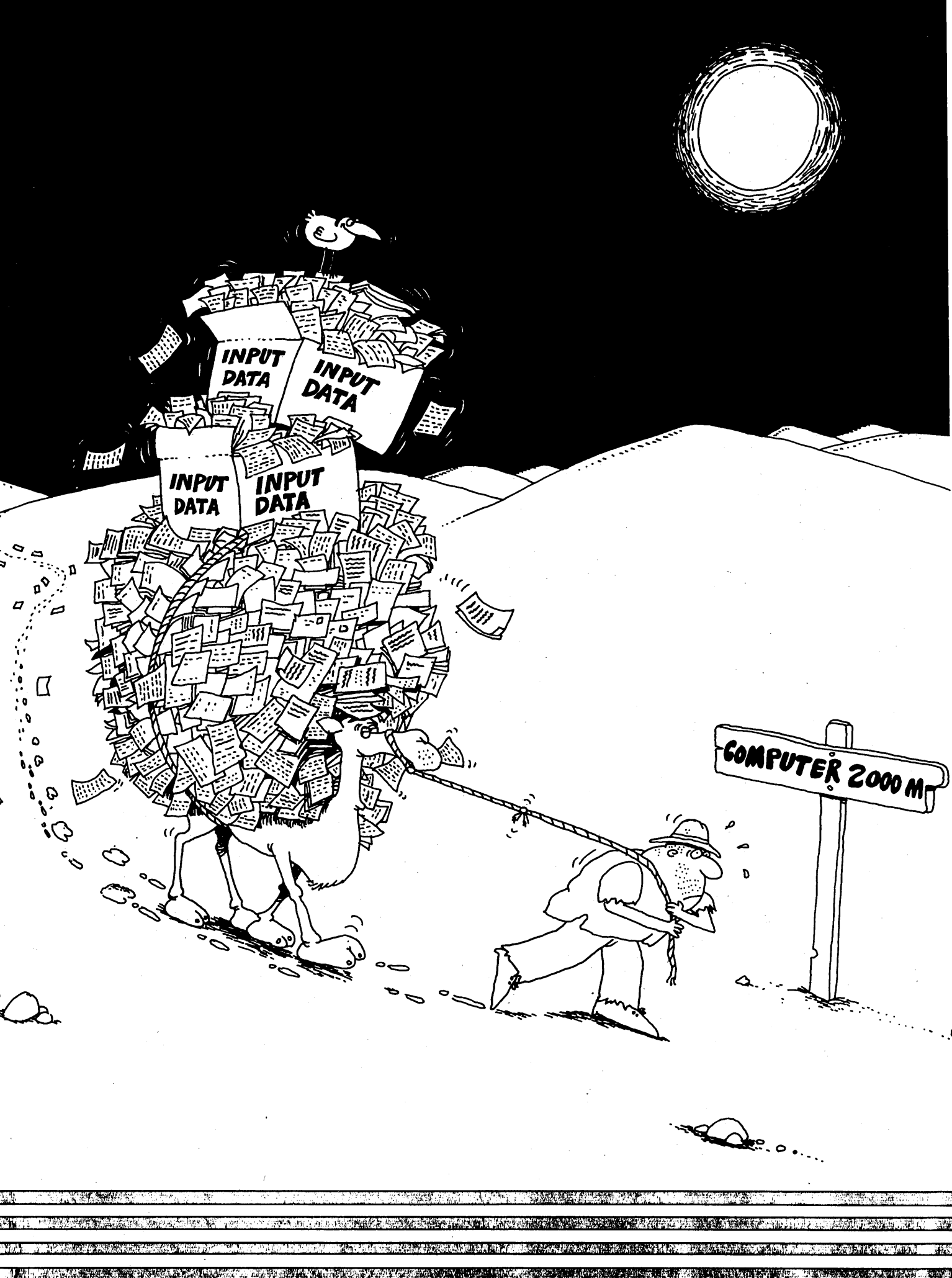
now and over the next five years in 25 countries around the world. For new installations. Expansions: It can tell you what EDP products are most in demand. How to sell them most effectively.

The Bureau of International Commerce will help you in more ways than you can imagine...and so will Sea-Land, the international intermodal transportation company. Sea-Land can show you how containerization can put your EDP machinery and related equipment right on the doorsteps of overseas customers.

Write today on your business letterhead for your copy of the EDP Global Market Survey and find out how really easy it is to expand your marketing horizons. Copies may be obtained from your local U.S. Department of Commerce field office or from Sea-Land Service, Inc., Dept. A, P.O. Box 1050, Elizabeth, New Jersey, 07207.



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FORTRAN optimizations that the user can perform manually at the source code level to improve object code performance

The Efficient Use of

The FORTRAN user is concerned, basically, with four distinct factors, all of which influence turnaround time and job cost: compiler size, compiler speed, compiler-generated object program size, and compiler-generated object program speed.

The size and speed of the compiler are of interest to the FORTRAN user during the development and debugging stages of a program. If the compiler is relatively large, a FORTRAN job might often find itself at the bottom of the scheduling queue competing for core space. On the other hand, the space requirement of any language translator is often (not always) an indicator of its speed—faster compilation speed in return for larger core requirements. For many compilers, the space requirement is a function of the size and complexity of the source program being compiled.

While both the size and the speed of the FORTRAN compiler are important factors during the development cycle of a program, the user typically has little or no control over these factors. Many installations have only one FORTRAN compiler available, and, in developing a production program, the user would be ill-advised to code in such a way as to minimize compilation time or compile-time core space requirements. However, in installations where more than one compiler is available, it would be appropriate to compare their attributes and select a "development compiler" which would minimize program development costs. Many compilers provide the user with certain compile-time options, each of which has a direct effect on compiler performance and job cost. Again, it would be appropriate to study these options and set defaults (or prepare recommended option lists) which minimize compilation time for programs in the development stage. Perhaps the most glaring abuse of compilation options is the selection by many installations to print the compiler-generated object code by default.

When a FORTRAN program reaches the production

stage, the user is concerned only with the performance of the compiler-produced object code. The compiler or compilation options selected to generate the production object code should be the one which most highly optimizes the object code for the target machine. Compilation time and compiler core space requirements for this process are no longer an issue because this is presumably the final compilation. If an optimizing compiler exists for a certain class of machines but its size or purchase price is prohibitive for a certain installation, it might prove economical to pay for a compilation of production programs at an installation where such a compiler is available, assuming the resulting object programs are not too large for the original installation.

Most language translators have no compile-time options which relate to object code optimization. This is not to say that any such compiler does not optimize object code, but rather that the compiler unconditionally applies a fixed set of optimizations to all programs. It is conceivable that such compilers might produce more highly optimized object code than do compilers providing explicit optimization options.

The number and type of optimizations performed by compilers are many and varied. Basically, optimizations fall into two main categories:

1. machine independent optimizations, and
2. machine dependent optimizations.

In each category there are optimizations for speed and optimizations for size of the object program. The optimizations for speed vs. size are almost always conflicting with one another.

In the absence of a definitive document describing precisely all optimizations performed by a given compiler, it is extremely difficult to determine the conditions under which optimizations are done. It is even more difficult to determine the degree to which global optimizations are performed because global optimizations are usually constrained by available core storage during compilation, the amount of which is often too small to accommodate an entire subprogram.

FORTRAN

by Chris Larson

Another significant point is that even the most sophisticated optimizing compiler has no way of knowing which sections of the program being compiled will be executed most frequently. If the compiler assigns equal weight to all sections, optimizations for infrequent paths often tend to interfere with optimizations for the more frequent paths.

It is important that the FORTRAN user become familiar with certain coding techniques which tend to result in fairly good object code regardless of the compiler. The remainder of this paper addresses itself to FORTRAN optimizations that the user can perform manually at the source code level to improve object code performance. Certain optimizations for speed will increase the size of the object program, and certain optimizations for size will increase execution time. It must be the user's decision as to whether any optimization will have any real payoff, based on the execution frequency of the code in question.

The use of these techniques clearly does not eliminate the need for an optimizing compiler because:

1. Many of the machine-dependent optimizations (such as register assignment) cannot be anticipated and/or guided by the user's source program.
2. Even the most highly optimized source program can be enhanced by an optimizing compiler.

In fact, a few of the source code optimizations listed below may actually be detrimental in that they may obscure the intent to certain compilers, but this will be mentioned in each case.

The purpose of the following section is to describe how FORTRAN compilers deal with source code constructions written by the user. The intent is not to describe in detail how each compiler works or to provide lists of specific coding rules because compilers are different, and each compiler would then require separate treatment. It is hoped that the following section will provide the user with a feel for those things in FORTRAN source coding which usually have a direct effect on the object code produced by various compilers.

Unless otherwise specified in the following sections, all examples will use standard FORTRAN naming conventions (i.e., an INTEGER identifier begins with the letters I, J, K, L, M, or N, and everything else is REAL).

Input/output statements

The most neglected area of optimization by FORTRAN compilers is in the handling of input/output statements. Typically, hundreds of non-I/O statements can be executed in the time it takes to execute one I/O statement, and this disparity can seldom be attributed to hardware I/O characteristics. FORTRAN programs which, from the source listing, appear to be I/O bound are, instead, usually CPU bound. Compiler optimizations for I/O statements are difficult because of supervisory system constraints and the interpretive nature of I/O statement execution. Following are a few techniques for optimizing I/O statements at the source level.

1. All files which are created by FORTRAN programs and used only as temporary files or as input to other FORTRAN programs should be referenced via *unformatted* READ/WRITE statements. Unformatted I/O statements are executed more quickly than formatted ones because the unformatted mode requires no conversion or formatting of data from internal to external graphic representations or vice versa.

2. All I/O and file control statements are time consuming because they result in calls to generalized FORTRAN subroutine library programs, which, in turn, make requests of the supervisory system. The user should attempt to minimize the number and frequency of such statements. (For example, two or more successive READ or WRITE statements referencing the same file might be combined into one statement.)

3. The time required to execute a READ/WRITE statement (formatted or unformatted) is a function of the number of data items in the I/O list. Most compilers produce one FORTRAN library call per data item

in the I/O list. A scalar variable is treated as one item, and an array name (with no subscripts) is treated as one item. A subscripted variable is equivalent to a scalar. However, an implied DO-loop in an I/O list represents $n \times k$ items in most compilers, where n is the number of iterations of the loop and k is the number of variables under control of the DO. The user should attempt to minimize the number of items in I/O lists. For example:

```
DIMENSION X(20), Y(10), Z(5,30)
```

```
35 WRITE(6,99) M,(X(I),I=1,20),Z(M,J)
```

The above WRITE statement, to most compilers, represents 22 data items. If it were changed to:

```
35 WRITE(6,99) M,X,Z(M,J)
```

it would represent only 3 data items.

Changing the implied DO-loop for X() to an array name reduces the number of data items by 19.

WARNINGS:

- Because of hardware characteristics, a few compilers (but not many) store arrays backwards (with ascending subscripts corresponding to lower storage addresses). The above change would output X in the order X(20), X(19), . . . , X(1). However, if the file is a temporary file, the change could be made consistently for all references to the file with no adverse effects (i.e., if an array is written out backwards, no harm is done if it is read in backwards later).
- The elimination of implied DO-loops for multi-dimension arrays in I/O lists in favor of array names is equivalent only if the implied DO-loop is consistent with the implicit indexing used for array names (i.e., which subscript varies most rapidly).

A few compilers do not permit an increment value in an implied DO-loop in an I/O list, thereby fixing the increment at 1. Given this restriction, it is always possible for the compiler to effect the change in the above example, even if the range of indices in the implied DO spans only a portion of the array. For such compilers, the two WRITE statements above would produce equivalent code only when the increment with no such restriction, may effect the change automatically if the increment is 1.

A change like the above at the source code level produces equivalent code only when the increment value is 1 and the final value of the implied loop is equal to the dimension size of the variable involved.

Another, and perhaps the most optimum, way to reduce the number of items in an I/O list is to change

```
DIMENSION X(20), A(10,4)
```

```
WRITE(12) M,I,A,X,Z
```

to the following:

```
DIMENSION X(20),A(10,4),Q(63)
COMMON/BLOCK/M,I,A,X,Z
EQUIVALENCE (M,Q(1))
```

WRITE(12) Q

For I/O lists containing a large number of data items, the above change might result in a significant performance gain, because a single data item replaces all items in the original list.

4. I/O statements which provide asynchronous input/output, if available in a given compiler, are almost always preferable to the READ/WRITE statements of Standard FORTRAN (e.g., BUFFER IN/BUFFER OUT statements of CDC FORTRAN). The use of such statements places the burden of buffering and data conversion on the user, but a substantial increase in execution speed usually results.

5. If the facility exists, allocate large buffers for each FORTRAN file, which may minimize the number supervisory I/O requests made by the FORTRAN subroutine library. For OS/360 FORTRAN, which imposes an upper limit of two buffers per file, programs with a large amount of printed output can be improved significantly by simply overriding the IBM-supplied GO STEP DD statement for the printer as follows:

```
//GO.FT06F001 DD SYSOUT=A,DCB=(RECFM
=FBA,LRECL=133,BLKSIZE=7182)
```

6. As a last resort for production programs with heavy I/O usage, it might be worth the effort to replace all frequently executed I/O statements with CALL's to special user-written assembler language subroutines which perform the desired function.

Subscripts

Many FORTRAN compilers permit almost any valid arithmetic expression as a subscript. Most compilers, however, recognize certain "preferred" constructions of subscript expressions which permit optimizations to be made. Some FORTRAN compilers, in fact, restrict subscript expressions to this preferred set.

The preferred set of subscript expressions is:

- V (scalar integer variable)
- C (positive integer constant)
- $V \pm C$ (scalar integer variable plus or minus a positive integer constant)
- $C * V$ (positive integer constant times a scalar integer variable)
- $C_1 * V \pm C_2$ (positive integer constant times a scalar integer variable plus or minus a positive integer constant)

It is not sufficient that a subscript expression be algebraically equivalent to one of the preferred constructions—it must be *exactly* in the above form to be recognized (e.g., X(3+J) will usually result in a more lengthy object code expansion than will X(J+3)).

The above set of preferred constructions was not determined arbitrarily. Each one was chosen because it permits a partial evaluation at compile time so that, in the worst case (#5), at most one addition is required at execution time to isolate the array element for that dimension.

Consider the following sequence:

```
M = J - 5
X = A(M) + T
```

It is almost always more efficient to replace the above with

$$X = A(J-5) + T$$

because $J-5$ is computed at object time in the first case, whereas 5 is effectively subtracted from the base address of A at compile time in the second case. (The above change assumes that no path can be reached which contains a use of M prior to a definition of M .)

Subscript computations at object time are especially expensive for multidimensional arrays. It is always best to apply the rule "Never use a vector when scalars will do, and never use an N -dimensional array when an array of $N-1$ dimensions will do."

If arrays are necessary, it is best to use constant subscripts wherever possible. If a constant subscript is used with a vector (e.g., $X(7)$), the resulting object code will resemble a reference to a scalar. In general, a constant subscript in any dimension of an array reference will have the effect of reducing the rank of the array by one *at compile time*.

If multidimensional arrays are essential to an algorithm, the complexity of references may sometimes be reduced. Consider the following example:

```
DIMENSION X(10,20,8),Z(30,30)
.
.
.
DO 5 I = 1,10
DO 5 J = 1,20
DO 5 K = 1,8
5 X(I,J,K) = 0
.
.
.
DO 75 I = 1,30
75 Z(I,I) = 1.0
.
.
.
```

The above could be changed so that an improvement in both core space and execution time would be realized.

The following code is functionally equivalent to the above:

```
DIMENSION X(10,20,8), Z(30,30)
DIMENSION XXX(1600), ZZ(900)
EQUIVALENCE (XXX(1),X(1,1,1))
EQUIVALENCE (ZZ(1), Z(1,1) )
.
.
.
DO 5 I = 1, 1600
5 XXX(I) = 0
.
.
.
DO 75 I = 1,900,31
75 ZZ(I) = 1.0
.
.
.
```

Changes like the above sometimes make the source coding more difficult to follow, but the performance improvement is often worth the inconvenience.

Data types and conversions

One of the most overlooked areas of source code optimization is minimizing the number of internal data conversions during execution. Strict *ASA FORTRAN* compilers, in a way, force the user to think about conversions by not permitting mixed mode expressions. However, because mixed mode expressions are permitted by some compilers, it is easy to write programs which compile error free and always produce correct output but which require many unnecessary data conversions during execution. In some compilers, such conversions result in calls to *FORTRAN* library subroutines; in others, in-line code performs the conversion.

Consider the following example:

$$X = I^*Z - (I-1)/T + I^*6$$

Two conversions from *INTEGER* to *REAL* are required, and some compilers would produce three. The expression $(I-1)$, because of the *FORTRAN* rules for expression evaluation, must be evaluated in integer mode and the result converted to *REAL*. The appearance of the variable I in two other places would cause either one or two additional conversions, depending on the intelligence of the compiler.

To reduce the number of conversions in the above example to one, use

$$V = I \\ X = V^*(Z + 6.0) - (V-1.0)/T$$

where I is converted to *REAL* by the assignment statement $V=I$. Collecting the first and last terms in the original example and factoring also saves execution time by reducing the number of multiplies.

Following is another example which illustrates that the most elegant algorithm may not be the most efficient:

```
DO 4 J = 1,1000
4 X(J) = J
```

The above will result in 1,000 conversions of J from *INTEGER* to *REAL* at execution time. The following code, while more lengthy in its source form, will execute faster and, for most compilers, take less core space because no conversions are required:

```
Z = 0.0
DO 4 J = 1,1000
Z = Z + 1.0
4 X(J) = Z
```

Conversions from *INTEGER* to *REAL* and vice versa are usually more costly than conversions from *REAL* to *DOUBLE PRECISION*. Conversions from *DOUBLE PRECISION* to *REAL* are usually free, as are conversions within the *INTEGER* category (i.e., *INTEGER**2 to *INTEGER**4 and vice versa).

It would be wise for the user of a *FORTRAN* compiler to determine how the compiler handles constants with respect to data type. It would be easier for a compiler to ignore the context in which a constant is used and simply preserve the type specified by the

user rather than to perform a compile-time conversion of the constant to the type most optimum for execution. For example:

```
IF (X.EQ. 17) K = 2.0
```

A "quick and dirty" compiler might emit object code which contains conversions of 17 from `INTEGER` to `REAL` and of 2.0 from `REAL` to `INTEGER`. If such is the case, the user should always attempt to match the constant type with the type of usage, which, for the above example, would become:

```
IF (X.EQ. 17.0) K = 2
```

External subprograms

It is always costly in terms of execution speed to invoke external subprograms. There are several different forms of external subprograms:

1. `SUBROUTINE` and `FUNCTION` subprograms supplied and explicitly invoked by the user.
2. Intrinsic functions and subroutines provided by `FORTRAN` which are explicitly invoked by the user (e.g., `SIN`, `SQRT`, `FLOAT`, `CALL OVERFL`, etc.).
3. Subroutines provided by `FORTRAN` which are invoked by I/O statements (e.g., `READ`, `WRITE`, `END FILE`, etc.).
4. Subroutines provided by `FORTRAN` which are implicitly and, in many cases, unknowingly invoked by the user to accomplish internal data conversion, exponentiation, and complex arithmetic. On a few machines, the `FORTRAN` compilers must use this mechanism to simulate `DOUBLE PRECISION` and possibly even `REAL` arithmetic.

Some compilers attempt to minimize external subprogram calls by expanding certain items in categories 2 and 4 as in-line coding. This often amounts to a considerable increase in execution speed at the expense of using more core space. A few examples of functions in category 2 which may result in in-line coding, depending on the compiler and compilation options, are: `MOD`, `IFIX`, `FLOAT`, `MIN`, `MAX`, `ABS`, etc.

Exponentiation (category 4) may result in in-line code only if the exponent is a positive integer constant *and* if the resulting in-line code (a sequence of multiply instructions) is shorter than the generalized out-of-line subroutine, which is usually determined by the compiler's inspection of the exponent value.

It is important to remember that many in-line copies of the same code sequence may appear when the compiler blindly produces in-line coding for many calls (either explicit or implicit) of the same function. Some compilers might determine the total number of calls of a particular function before choosing in-line expansions over a single copy of the out-of-line subroutine, but most compilers probably do not go to the trouble. And there is no compiler to my knowledge which, during the compilation of a single subprogram, emits both in-line and out-of-line code for the same function selectively, based on expected execution frequency. The only time when both in-line and out-of-line code for the same function is produced for a single subprogram is for `MIN`, `MAX`, exponentiation, etc., and the decision is based strictly on the number or size of function arguments and not on expected frequency of execution.

It is usually possible for the user to guarantee that only one copy of a function is present in the object code by declaring all such function names in an `EXTERNAL` statement. This is meaningful only for those functions in category 2 above.

To summarize, if core space is of no concern to the user, it is almost always best to permit in-line expansion of all functions which permit such expansion. The advantage to this approach is that no subroutine linkage is present in the resulting expansions and that such expansions are special-purpose subsets of the generalized out-of-line subroutine. On the other hand, if core space is to be conserved, it is best to declare such functions as `EXTERNAL`. Most `FORTRAN` compilers compile each subprogram independently of all others, so these functions should be declared as `EXTERNAL` in each subprogram to ensure only one copy in the object code after combining all subprograms for execution.

`FORTRAN` statement function definitions do not fall into any of the above categories because such functions are strictly local to the subprogram containing them. Such functions are always explicitly invoked by the user. Some compilers expand references to such functions with internal calls; others substitute in-line code for the definition at every reference, including expansions for nested inner references to other statement function definitions. However, the user never has a choice as to which method is to be used. If the user wants in-line expansions, he can always eliminate all statement function definitions and substitute the definition for every reference manually.

A previous section of this paper dealt with I/O statements, which always result in calls to `FORTRAN` library subroutines (category 3). Such subroutines are of necessity generalized and lengthy, so the user should attempt to minimize the number and frequency of I/O statements.

Like all other subprogram calls, a reference to an external user-supplied `SUBROUTINE` or `FUNCTION` (category 1) is expensive because of the linkage overhead, which is a function of the number of parameters and their usage. There is always a constant amount of linkage overhead present even if the subprogram has no explicit parameters. There is an additional burden placed on the object code of the calling program as a result of a `SUBROUTINE CALL`, because the compiler must emit code which assumes that every variable in every `COMMON` block specified by the calling program must be available to, and may be changed by, the called subprogram. In some cases, the effect of this assumption on register load/store activity could produce more overhead in the calling program than in the linkage itself.

Many compilers, because of hardware architecture, produce more efficient object code for programs containing a minimum number of `COMMON` blocks. This is because the placement of `COMMON` blocks is not a function of the compiler but of the loader, and each `COMMON` block requires separate addressability, which, for a program containing a large number of `COMMON` blocks, interferes with optimum register assignment. For machines with an elaborate indirect addressing capability, it would be possible for a compiler to emit code which is not hampered by this addressability problem. However, for most machines, it is probably best for the user to combine all `COMMON`

blocks into one.

As far as explicit subprogram parameters are concerned, it is generally best to minimize the number of parameters. Until recently, almost all FORTRAN compilers treated all parameters as "call-by-name," which means that the called program requires the external address of the parameter at every reference. For a called program containing many references to external parameters, a considerable amount of overhead is introduced. For such programs, it is usually best to move all scalar parameters to local variables at the outset in the called program and then use the local copy of the parameter at all subsequent references, which minimizes the number of explicit references to scalar parameters.

For example:

```
SUBROUTINE X (A,B,C,D,E,F,G)
  DIMENSION C(10,4), F(400), T(50)
  Y = A
  Z = B
  W = D
  S = G
  .
  .
  .
  (body of subroutine)
5 B = Z
  E = V
  RETURN
END
```

The above assumes that A, D, and G are input-only parameters, that E is output-only, and that B is both input and output. The arrays C and F could be either or both. Regarding the scalars A, B, D, E, and G, note that the minimum number of references is made to each, with the body of the subroutine using their local equivalents Y, Z, W, V, and S, respectively.

It is usually not worthwhile to move a scalar parameter to a local variable if the parameter is referenced only once or twice. It is never worthwhile to move array parameters to local arrays in the called program, especially for large arrays, because the overhead of moving them and the extra storage required probably far offset any performance gain that could be realized by so doing.

Some recent FORTRAN compilers have introduced a strain of the "call-by-value" concept whereby the user (in the SUBROUTINE or FUNCTION statement) declares which scalar parameters are to be moved to local variables within the subprogram. This capability eliminates the need for the user to perform these moves explicitly in the subprogram.

To summarize, it is generally best to minimize the number of parameters to a subprogram and also to minimize the number of references in the called program to each parameter. If a subprogram is called frequently, it might be well to investigate the effect of replacing the references with in-line source code, which, for multiple references, will increase the size of the program, but the resulting program will run faster. The decision to eliminate a subprogram in favor of in-line source code depends on the size of the subprogram and the number of references to it.

Also, there is no substitute for analyzing a problem before coding it. Consider the following statement, which contains a fairly commonplace construc-

tion used in numerical analysis problems:

$$X = X^*Y^*((-1)^{**}(I + J))$$

Most compilers would produce a call to the exponentiation subroutine and then convert the INTEGER result to REAL. The first improvement that comes to mind is changing (-1) to (-1.0), which produces a REAL result for the exponentiation. However, the exponentiation itself could be simplified and the conversion eliminated by using the following:

```
DIMENSION Z(3)
DATA Z/-1.0,1.0,-1.0/
.
.
.
K = MOD(I + J,2)
X = X*Y*Z(K + 2)
```

For compilers which emit in-line code for the MOD function, the generated code would contain no subprogram calls. This simplification in the source program is made with the assumption that the compiler has no equivalent "special case" optimization.

Expression evaluation

The user should always attempt, in the source program, to minimize the number of execution-time evaluations of an expression. Most compilers are able to do this automatically for the user for common subexpressions within a single statement only.

For example:

$$X(J^*I) = ((A^*B)/Y + T/(A^*B)) + Z(J^*I)$$

Most compilers would recognize that (A*B) and (J*I) are both used twice and would produce object code which evaluates each of these expressions only once.

Consider the following example:

$$Z = ((A + (1.0/X)) * (1.0/X)) / (4 - (A + (1.0/X)))$$

The expressions (1.0/X) and (A + (1.0/X)) would be evaluated only once. For compilers which recognize these common subexpressions within a single statement, two conditions are sometimes placed on the source code so that such subexpressions are detectable:

1. A subexpression is a candidate for detection as common only if it is parenthesized. Both examples above have parentheses surrounding the common subexpressions. If, in the first example, the first occurrence of the expression (A*B) had not been parenthesized, A*B would not have been recognized as being common and would have been evaluated twice. Note that subscript expressions are always candidates for this optimization because subscripts are always enclosed in parentheses (a comma separating subscripts for multidimensional arrays is an exception but can be handled internally by the compiler with no problems).

2. Two parenthesized subexpressions are recognized as being common only if they are identical. It is not sufficient that they be algebraically equivalent—they must be identical. For example, (A*B) would not be recognized as being identical to (B*A), although they are equivalent expressions. The defini-

tion of "identical" depends on the compiler—some do a character-for-character comparison of the source code (which would mean that 1.0 is different from 1.00) and others perform the comparison after encoding the expression internally (where equivalent constants would be considered identical).

Within a single statement, multiple references with identical arguments to the same function will usually result in only one evaluation of the function, regardless of whether the references are parenthesized.

The recognition of common subexpressions within a single statement is fairly commonplace among FORTRAN compilers. However, only a few compilers are capable of detecting and eliminating redundant evaluations of expressions on a more global basis (i.e., across many statements). But in the absence of information about any specific compiler, it is always possible for the user to write a source program which will minimize the number of evaluations of an expression, regardless of the compiler being used.

Even though a certain expression may appear only once in the source program, the flow of the program may necessitate its evaluation many times. Consider the following example:

```
DO 5 I = 1,100
  Q(I) = 0.0
  DO 5 J = 1,100
    5 Q(I) = Q(I) + A*B*X(J,I)
```

The subexpression $A*B$, although constant throughout both DO-loops, might be evaluated 10,000 times, depending on the compiler. Also, the effective address of $Q(I)$ might be computed 10,100 times even though it is constant throughout the inner loop on J . To eliminate the possibility of these redundant evaluations, the above code could be changed to

```
Z = A*B
DO 5 I = 1,100
  S = 0.0
  DO 4 J = 1,100
    4 S = S + X(J,I)
  5 Q(I) = Z*S
```

Again, an optimizing compiler capable of recognizing common subexpressions on a global basis could have produced, for the first example, object code resembling the latter example with two exceptions:

1. The multiplication by Z would appear in the inner loop if the compiler is incapable of algebraically factoring out the constant multiplier Z .

2. A new variable S would not be introduced, but the effective address of $Q(I)$ would be computed only once (in the outer loop). In this regard, it might actually be detrimental to the object code to introduce the variable S in the source program.

Another source code optimization (which a sophisticated compiler can also perform) that may only save core space is shown in the following examples:

```
.
.
.
.
.
IF( ) 6,6,3
6 ---
.
.
```

```
.
Z = A*B + T
.
.
GO TO 9
3 ---
.
.
.
X = A*B*Q
.
.
9 ---
```

Because of the IF statement in the above example, the paths at labels 6 and 3 are mutually exclusive. At execution time, the expression $A*B$ would be evaluated only once per execution of the IF statement, but the object code might contain the code for its evaluation in each path. This code could be eliminated by

```
R = A*B
IF( ) 6,6,3
6 ---
.
.
.
Z = R + T
.
.
.
GO TO 9
3 ---
.
.
.
X = R*Q
.
.
.
9 ---
```

It is often desirable, for purposes of documentation, to include in the source program expressions containing only constants. For example:

```
M = (3159-2103)/16
IF(X.GT.7.0/3.0)X = 5.0
Y = SQRT(ABS(SIN(2.174*1.638)))
```

Before using constant expressions in a source program, it is advisable for the user to determine how the target compiler treats such expressions. Some compilers would recognize that an expression contains only constants and would evaluate it at compile time; other compilers would emit object code for evaluating the expression at execution time. In the latter case, a constant expression within a loop could be costly in terms of execution time, especially so in the case of the last statement in the above example.

Some compilers attempt to optimize the evaluation of logical expressions, especially in logical IF statements. Consider the following logical expression:

$$(e_1).OR.(e_2),...,OR.(e_n)$$

Some compilers will attempt to minimize execution

time for the above by terminating the evaluation upon encountering the first `.TRUE.` e_i . If the operator were `.AND.` instead of `.OR.`, evaluation would terminate upon encountering the first `.FALSE.` e_i . In each case, the remaining e 's would not require evaluation and thereby save execution time. To take advantage of this optimization, the user should arrange the e_i subexpressions in a left-to-right order such that the leftmost would most frequently cause termination of the evaluation of the entire logical expression.

Machine-dependent optimizations

There are a few miscellaneous optimizations related to the evaluation of expressions which are machine dependent:

1. Since an add instruction is usually much faster than a multiply, it is usually best to replace a "multiply by 2" with an add:

$(2.0 * X)$ would become $(X + X)$

- a. This change should not be made for "preferred subscripts."
 - b. This change should not be made for a binary machine if the compiler is capable of reducing the strength of the multiply to a shift instruction.
2. Since a multiply instruction is usually faster than a divide, it is best to use multiplies wherever possible:

$(X/4.0)$ would become $(X * 0.25)$

3. For exponentiation using small constant integer exponents, it is usually best to replace the operation with a series of multiplies:

$(X ** 4)$ would become $(X * X * X * X)$

A few compilers may be able to perform all the above optimizations automatically for the user. But, in the absence of information about specific compilers, the user should make these optimizations manually.

Miscellaneous optimizations

1. Because of comparative execution speeds typical of most machines, the following general rules usually apply:

- a. Never use a `REAL` variable when an `INTEGER` will suffice.
 - b. Never use a `DOUBLE PRECISION` variable when a `REAL` variable will suffice.
2. To save core space, use `EQUIVALENCE` statements to effect overlays of arrays when possible.
3. Whenever there is a choice, use compile-time `FORMAT` statements as opposed to variable object-time `FORMAT` statements. Some compilers encode compile-time `FORMAT` statements so that they may be more quickly interpreted at execution time.
4. For some compilers, it may be advantageous for the user to manually "unroll" loops to gain execution speed.

If

```
DO 5 I = 1,1000
5 X(I) = 0.0
```

were changed to

```
DO 5 I = 1,1000,2
X(I) = 0.0
5 X(I + 1) = 0.0
```

a gain in execution speed might be realized. The loop-closing code produced by some compilers is fairly lengthy, and the above example reduces the frequency of such code by a factor of 2. The latter approach clearly takes more core space, however. Also, there is a point of diminishing returns in applying the above approach to larger increment values in the `DO` statement. Taking this approach to its extreme, the loop would be completely eliminated in favor of in-line code (1,000 source statements for the above example).

Conclusion

Many of the recommendations set forth in the previous section seem to be defeating the purpose of a high-level language, which is to free the user from restrictions, details of machine characteristics, etc. While a language unencumbered by restrictions may be easier to use than a rigid one, it is usually more difficult for a compiler to optimize. Until compiler optimizations for a given language become extremely well refined and universally applied, the user who is truly concerned about object code performance must be willing to share the optimization burden. Such a user could minimize the amount of his time required for optimization of source programs if compilers would optionally provide him with feedback data regarding the execution of his programs.

For `FORTRAN`, this could be accomplished if the compiler optionally inserted frequency collection code into the object program at every node and expanded all `STOP` statements into calls to a `FORTRAN` library subprogram which merges the original source program with the frequency data to form an "execution report." Such a report can be obtained now by editing the source program prior to compilation, but it seems more appropriate and economical for compilers to provide this service as an option. Also, this report could conceivably be used as input to a subsequent compilation so that the compiler could place the optimization emphasis in the most frequently executed areas of the program. ■



Mr. Larson is a systems performance analyst with Computer Synectics, Inc., Santa Clara, Calif. — a company which deals in systems measurement products and services. He previously worked as a systems programmer in various software development areas for IBM, Control Data Corp., and Stanford Univ. He has a BA in mathematics from Texas A&M Univ.

what!



really!



yes, mag
tape
terminals



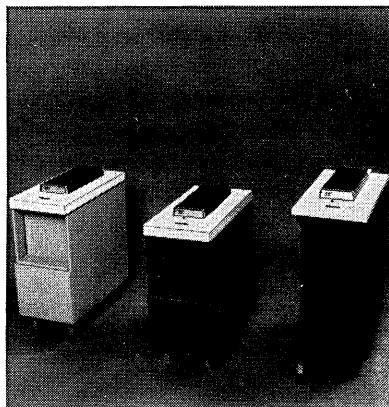
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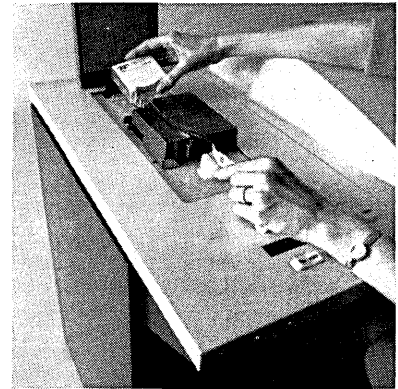
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The units have a "fast access" switch which will move tape forward or reverse at a speed of 33 inches per second. A digit counter provides a reference point to help locate various areas of the tape.

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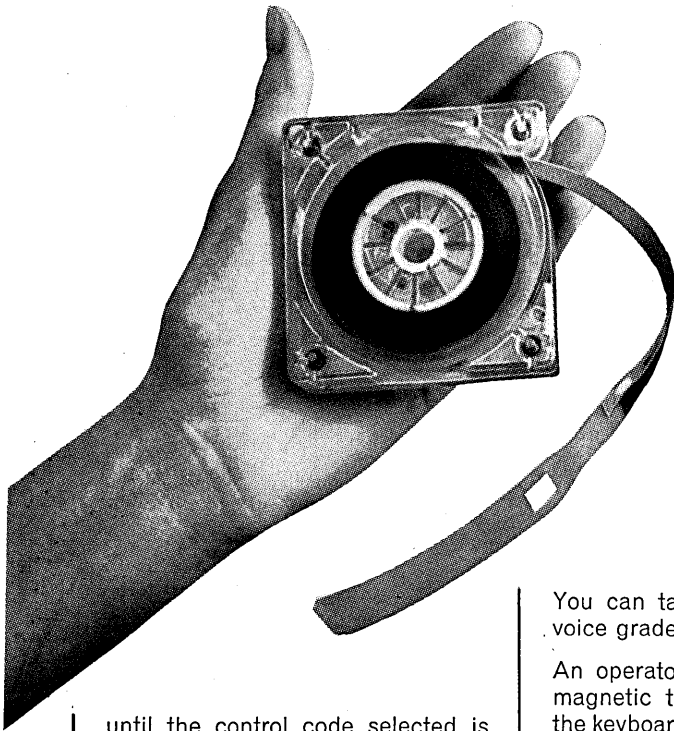
You can zip data along the line at up to 2400 words per minute. For example: Take a standard speed Teletype keyboard send-receive set, and a typical typist. Add a new magnetic tape unit to this combination and the on-line time savings can pay for the magnetic tape terminal in short order.



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August 1, 1971

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**What you always wanted
to know about European jobs
but were afraid to ask**

Job Hunting?? You



Working in Europe has always had an attraction for many American professionals.

"Aren't the salaries much lower?"

"But I don't speak any foreign languages."

"Wouldn't my children's schooling be interrupted?"

Questions and doubts on languages, standard of living, and work content have deterred most of us from seriously considering European job opportunities. However, with the U.S. computer industry somewhat depressed, and with European computer manufacturers actively advertising in American newspapers and magazines for experienced programmers and systems people, it may be worth reviewing some features of the European data scene.

We will assume, for the moment, that you are not

**... the warmth and
companionship of the English
pub can be worth the salary
difference in itself.**

one of the (relatively) lucky few who has found a position with a U.S. company overseas, and are therefore receiving a possibly tax free salary plus healthy subsistence allowances. We will consider instead the exigencies of working with a European manufacturer or user at European salary levels. (See Table 1.)

If you're not very good at languages, your best bet is England or Scandinavia. The economy in England is doing fairly well, although there are inflation problems and some indications of a turn down soon. There is only one British computer manufacturer of real significance to the job hunter—International Computers Limited. ICL, which in the U.K. outsells IBM, has plants in many parts of Britain. The company was formed by a series of mergers of smaller operations, and it seems that just as it was settling down, another set of mergers took place. The resulting confusion hasn't ended yet. However, it is clear that ICL recognizes its problems and is dealing with them. For the job hunter, ICL probably offers the best prospect in the area of systems software design and systems software implementation. Good applications program-

mers might give it a try, too.

Most of the other manufacturers are U.S. dominated. IBM and Honeywell are strong, as are NCR and Burroughs. As an American, however, you may get some resistance against a local hire (this would put you at a radically different salary scale from other Americans employed by the operation).

There are some big time-sharing and software consulting operations that may be worth talking to if you have had direct experience on the equipment they are using (SIGMA 7, 1108, 360/65, etc.). You will get British salary scales, but may do a little better than the manufacturers.

There are some big user companies in England, who are ready and willing to hire experienced American professionals. Manufacturers and insurance companies are worth a try, but banks are questionable (there's a lot of differences in banking practices between Britain and the U.S.). Some of the large state-owned enterprises may need you pretty badly but may not be able to hire you very readily. Small companies may be very interested in you but be quite fussy about your having had direct experience with the specific application or computers that concerns them.

Work permits in England are something of a headache. If you have arranged the job Stateside before you go, there isn't too much problem in getting a work permit. However, you can go to England as a tourist, even if you don't have a job. You can then stay at least three months, which gives you the opportunity to locate a job and get the necessary visa.

A senior programmer earns around £3,000 (\$7,200). Since the same man would be getting at least \$14,000 to \$15,000 in the U.S., he certainly is going to feel the pinch, financially. Housing is going to be pokier, heating in winter problematical, and there will be problems with the cost of owning and operating an automobile (80¢ per gallon for gasoline). On the other hand life is more relaxed, there is less pressure to produce at work, and the warmth and companionship of the English pub can be worth the salary difference in itself. Also, food, theater tickets, and services are much less expensive (70¢ for a haircut).

Scandinavia is a lot of fun. Most people that you will come in contact with speak English. You can, for the most part, use English at work, at least until you

Could Hop the Pond

by Kenneth G. Bosomworth

pick up a little of the local language. Salary scales are about mid-way between England and the U.S., so you're going to feel the salary reduction bite a little less keenly than in England. The problem in Scandinavia is going to be finding a job. Most companies can find local Swedes, Norwegians, or Danes with excellent edp qualifications. They are going to hire these people in preference to a foreigner.

But once again the specialist can find a niche. IBM introduces most of its products a little later on the European market than the U.S. market. Accordingly, you may have direct U.S. experience on something that is brand-new in Scandinavia. If you can show that you have such a unique experience, there's a good chance that one of the largest of the Swedish, Norwegian, or Danish companies will put you on its payroll.

You're going to have some problems in getting the necessary work and residence visas. There tends to be a chicken-and-egg situation. If you have a work visa, you can get a job. If you have a job, you can get a work visa. Without one, getting the other is difficult. This situation is true of several other European countries and it's a little difficult to handle. Obviously, it's best to research the whole visa question thoroughly with the consulate of a country before you go there. You may still have to lie a little, or assume a posture of blue-eyed innocence when you are found out.

(The Swedes may not have a sense of humor when they find that you have been breaking one of their rules. One innocent American programmer bought a Mercedes-Benz in Stockholm. It was only three years

old, and ran beautifully. It looked OK, too. What is more, it was about a fifth of the price of a new Mercedes. One night, he was stopped by a very efficient-looking police roadblock. He noticed that most of the police were wearing mechanics' coveralls. Next thing he knew, the car was driven up onto a portable ramp, and four police were pounding the underside with ice picks. To cut a long story short, the police found a patch of rust underneath—about the size of a dime—and impounded the car as being undriveable. It was later explained to him that his bargain Mercedes was almost worthless. Swedish law forbids driving any automobile which is rusted—even a little bit!)

Germany should give you fewer problems in the area of visas, although maybe as many in petty officialdom. But it really is necessary to be able to speak German pretty early in the game. Many of the Germans that you deal with will speak English fluently, but then again many will not and you can run into real problems in communications. German salaries are not up to Swedish levels. Nevertheless they are a good deal better than English rates.

In most German companies you will find a busy and competitive atmosphere. The large manufacturers, Siemens and AEG-Telefunken, are going to be a little reluctant to hire you unless they can see that you are going to be with them for some time. Most of the smaller companies and the users are less fussy, and at present your chances of being taken on by a German company are relatively high.

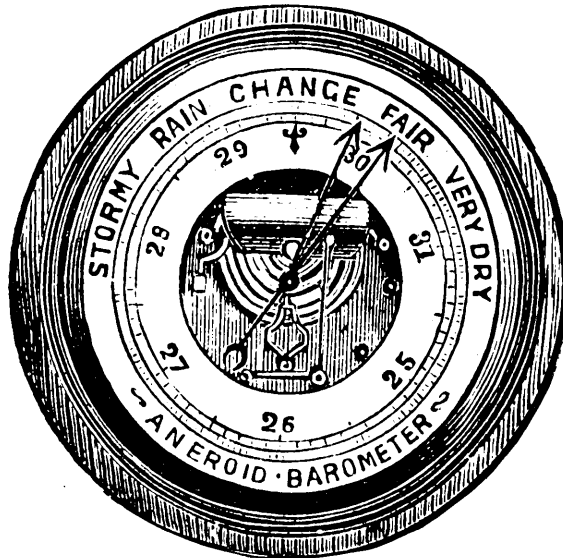
The French national computer company (Com-

	U.S.	Belgium	France	Germany	Italy	Lux'bg	Neth'ds	Sweden	U.K.
Direct Salary	\$14-18K	\$7-11K	\$8-12K	\$7-12K	\$6-13K	\$7-10K	\$7-10K	\$8-13K	\$6-10K
Tax Rates (effective average tax rates for family of four) On \$10,000 sal.	11%	25%	10%	20%	24%	25%	29%	35%	25%
On \$20,000 sal.	17%	35%	19%	27%	36%	39%	44%	48%	36%
Typical value of fringe benefits % e.g. company car, health insurance, extra vacation, bonus, etc.	10%	15%	15%	10%	20%	15%	15%	15%	20%

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Table 1. Typical salary rates for senior programmer or systems analyst.

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Job Hunting . . .

pagnie Internationale pour l'Informatique) is having plenty of problems, but it is quite receptive to certain categories of specialist computer systems people. If you've had less than seven or eight years' experience, it probably isn't worth talking to them. However if you're a first rate product planner, they may even offer you a U.S.-level salary. A good working knowledge of French is virtually essential for any job in France. All work is conducted in French, and very many people around you will have no knowledge of English whatsoever. If you're married, your wife had better speak French, too.

Professional and specialist jobs in France are concentrated almost totally in the Paris area. There are very few opportunities in the Provinces. This means that you must be prepared to pay Paris prices—at least as high as New York—for accommodations, food, services, etc. To make up for this, you will get a salary that is better than most other parts of Europe. There is a sizable American community in Paris, and you

**. . . the prices in Paris
are so high that without
good advice you're not
going to survive.**

should be able to get a lot of good advice on where to live and what to buy. As a matter of fact, you had better ask around because the prices in Paris are so high that without good advice you're not going to survive. In particular, you need good advice on visas and taxes, neither of which pose any problem if you are suitably advised.

Switzerland used to be the first choice of many Americans considering European job opportunities. The strict visa requirements in Switzerland have, for all practical purposes, made it completely impossible to take a job there under normal circumstances.

Belgium, the Netherlands and Luxemburg (the so-called Benelux countries) can offer some good opportunities. The people are hospitable, and there is a big American community in Brussels. If you're young, you may find these countries a little staid, and the taxes can bite. But, after all, Paris is only a stone's throw away. Quite a number of Americans (and, incidentally, Belgians and Dutch) rent a tiny studio apartment in Paris, which they use every weekend. Some of the more amorous find that the accommodation problem in Paris takes care of itself.

Italy may be the best bet of all. With the right experience, the right personality, and the right finesse, you can obtain a job with an Italian computer user at full U.S. rates (and live like a king) but you need the right contacts, and the appropriate flair, to locate and secure such a position. The same applies (in lesser degree) to Greece and Spain. There can be some outstanding jobs, but you need to know where they are before you go. Obviously, learning where the bigger IBM, Univac and Burroughs computers are installed can be a big help in locating possible employment opportunities.

Another way of locating possible good opportunities is by a friendly chat with the local U.S. consul. As

a matter of principle, he will at first discourage you from seeking employment. But after you've talked to him for awhile he probably will help lead you to some prospective employment.

Other ways of looking for work overseas include buying the appropriate overseas newspaper or magazine, talking with the foreign consulates or embassies, or finding a recent immigrant from that country who could give you a good first-hand view of conditions there.

Professionally, the experience of working abroad a few years is going to be a mixed one. The United States is typically the leading source of innovation in the computer business, and is ahead in most aspects of computer work. There are a few exceptions. European manufacturers have made important contributions to basic information theory, to the design of certain types of peripherals, and have taken the lead in some application areas. The chances are, however, that you will find a position where the equipment and the applications development are some months or years behind the U.S. In general, therefore, the benefits of your years working overseas are going to be in breadth of perspective, linguistic ability, and the other wide cultural benefits of living overseas.

Quite possibly, however, you'll be able to leap into a very senior technical position in Europe on the strength of your U.S. experience and qualifications. Then the responsibilities you'll be given will give you valuable experience, and perhaps give you a commanding advantage in two or three years' time when you return Stateside.

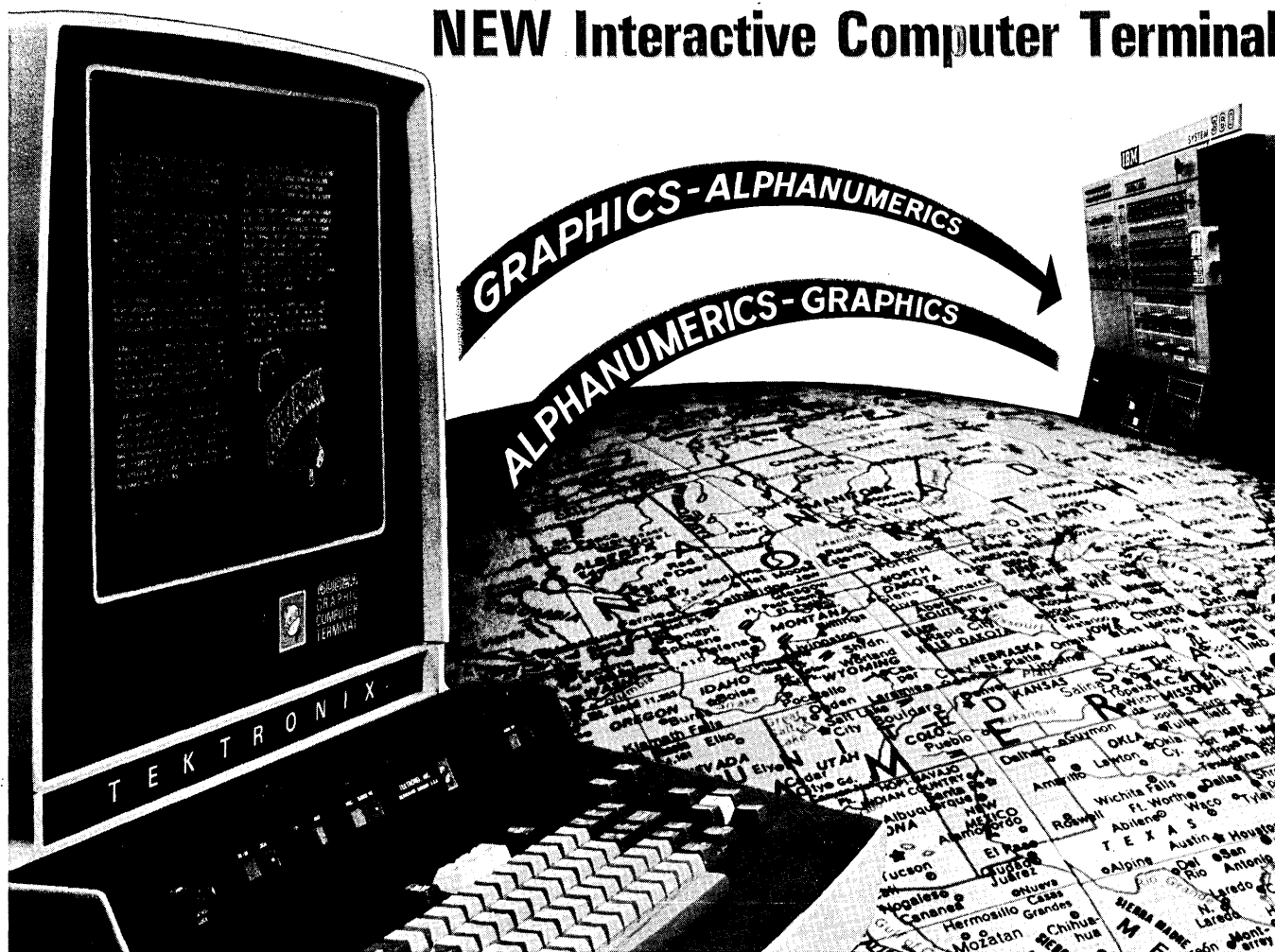
By the way, don't forget that Europeans have different standards of electrical voltage and frequency, and so most American appliances won't work in Europe. Most experienced transatlantic travelers will tell you to ship as few household possessions as possible over the Atlantic. Store your furniture in the U.S. and then buy what you need locally. It's worth looking into the shipping of automobiles, too. Depending upon which country you are going to and how long you are staying, it can pay (and is quite legal) to buy an automobile tax-free in Europe or (under certain circumstances) ship your American car to Europe and sell it there.

Bon Voyage! ■



When his company transferred Mr. Bosomworth from Paris to New York last year, it was his sixth international move in his ten years in the computer business. A senior staff consultant with Data Systems Analysts, he is also on the board of International Resource Development, Inc., specialists in international licensing and marketing of computer products. His master's degree is from Cambridge Univ., England.

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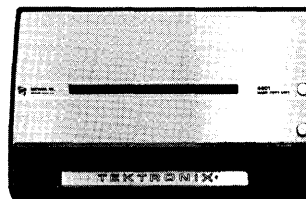
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A Conference Report

Computers in Process Control

G Mardi Gras season was in full swing 80 miles down the Mississippi River in New Orleans when the 6th Annual Conference on the Use of Digital Computers in Process Control opened on the Baton Rouge campus of Louisiana State Univ. Through the doors of Pleasant Hall came 148 men from 100 companies located in 29 states of the Union. Representatives of the large chemical and oil companies dominated the attendance followed by various control system vendors including a dozen computer vendors, mostly minicomputer manufacturers.

Dr. Cecil Smith in his keynote remarks set what was to be a recurring theme throughout the conference when he spoke of the "advent of the minicomputer" in process control applications, saying "... another dimension has been added to the avenues open to the system designer. With these less expensive machines, he can implement limited functions that are not sufficient to justify the larger systems."

Another relatively new concept aired in several sessions was that costs increase when you apply computers to process control systems. This is a distinct change from the early systems which vendors justified on the basis of dollar savings by replacing expensive analog hardware and human operators with a less expensive computer system. Except in a few instances this has not proven true. "You might cut a few people, but the price you pay for the ones you keep entails a larger expenditure," Dr. Smith remarked, "so the economic return must be from improved performance."

Mac Rivkin of Westvaco Corp. in the panel session on "Sizing the Computer for an Industrial Control System" pointed out that in the paper industry it is no longer sufficient to determine whether a process computer should be installed or not. The decision is to choose from three types of systems. These include (1) the

user-applied minicomputer, (2) the vendor-supplied dedicated computer control system, and (3) the large flexible process control computer. The panelists detected some movement towards vendor-supplied systems particularly for companies with systems capability.

Richard Koeller of Inland Steel cautioned potential purchasers of vendor systems to specify a minimum size—"else you'll end up with an absolute minimum hardware in the competitive bidding." He recalled the results of such a situation when the message volume to 28 multiplexed Teletypes caused the operator to get the message six minutes after the steel passed his station. "The increased price of a larger computer is a relatively small part of the cost of all the other items—so it's better to estimate on the higher side of size."

Sizing the computer

The second afternoon of the conference was devoted to a panel discussion on "Sizing the Computer to the Task." A repeated theme throughout the discussion was the lack of a market for small dedicated Direct Digital Control (DDC) systems. One of the panelists knew a manufacturer who took seriously the market for 50 loop (\$50K) DDC systems, built such a system, and sold only one.

Saul Dinman, computer designer with CRT Computer Corp., pointed out that, in the under \$50K computer size, the primary market is not DDC but dedicated computers for sequence control systems such as numerical control. The computer is deeply imbedded in a functionally dedicated system with maybe an on-off switch visible.

Panelist David Waks of Applied Data Research felt that "the best thing you can do is to put a blank panel on front and a start-stop switch and do your best to convince people it isn't a computer—call it a controller or a processor, because as soon as you

call it a computer people expect it to do things it was never intended to do."

The minicomputer in a dedicated system should be viewed as "a collection of logic to be programmed to replace the former hard-wired sequence logic," according to Mr. Dinman. The advantages of a dedicated computer over the hard-wired logic are several: (1) The oems can service a broad line with only software changes. (2) The software for these systems is greatly simplified. (3) The systems can talk to one another. (4) Dedicated job-oriented languages permit direct manipulation by operator-technicians.

Examples of dedicated systems range from 2314 disc controllers using a 1K minicomputer to business applications "programmable" by a clerk who calls up various systems to be used. A member of the audience suggested it is best not to call such systems computers for the reason that it makes it easier to get past the purchasing agent. He admitted to having shipped computers as a "collection of spare parts."

In "Evaluating the Software," Mr. Waks classified programs into two broad categories, the program-creation software (compilers, assemblers, etc.) and the program-execution software (executives, math subroutines, etc.). Both categories are required and the user "must ascertain, for each computer being considered, the state of the advertised software, both in terms of completion and relative freedom from bugs."

For the three days of the conference Baton Rouge was enjoying cool, crystal-clear, early spring days which sharpened everyone's appetite for the local delicacies of chicken jambalaya and crawfish bisque. Other local entertainment was sparse. One conference attendee, overhearing someone describing the Louisiana state capitol building in Baton Rouge, asked if it would be in town till the end of the week.

—Robert J. Matherne

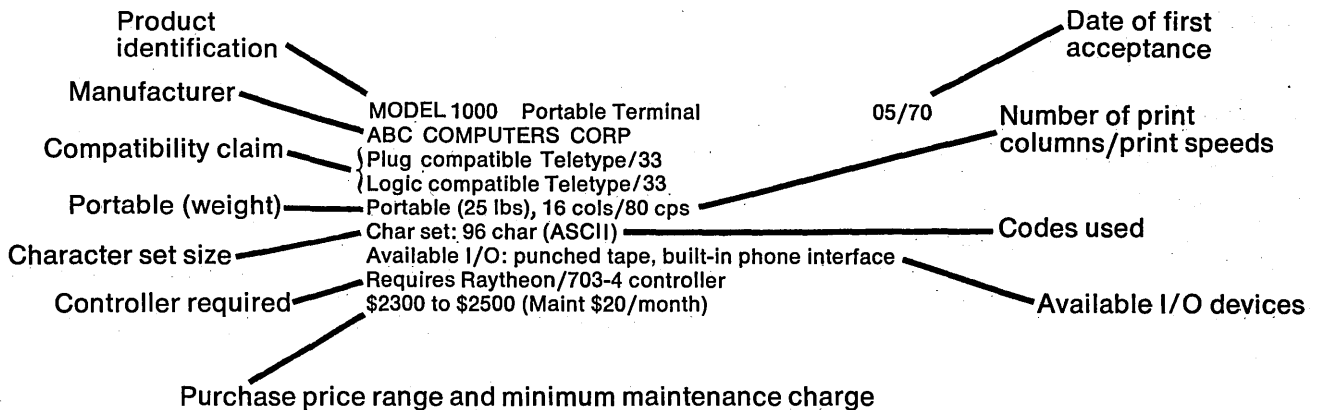
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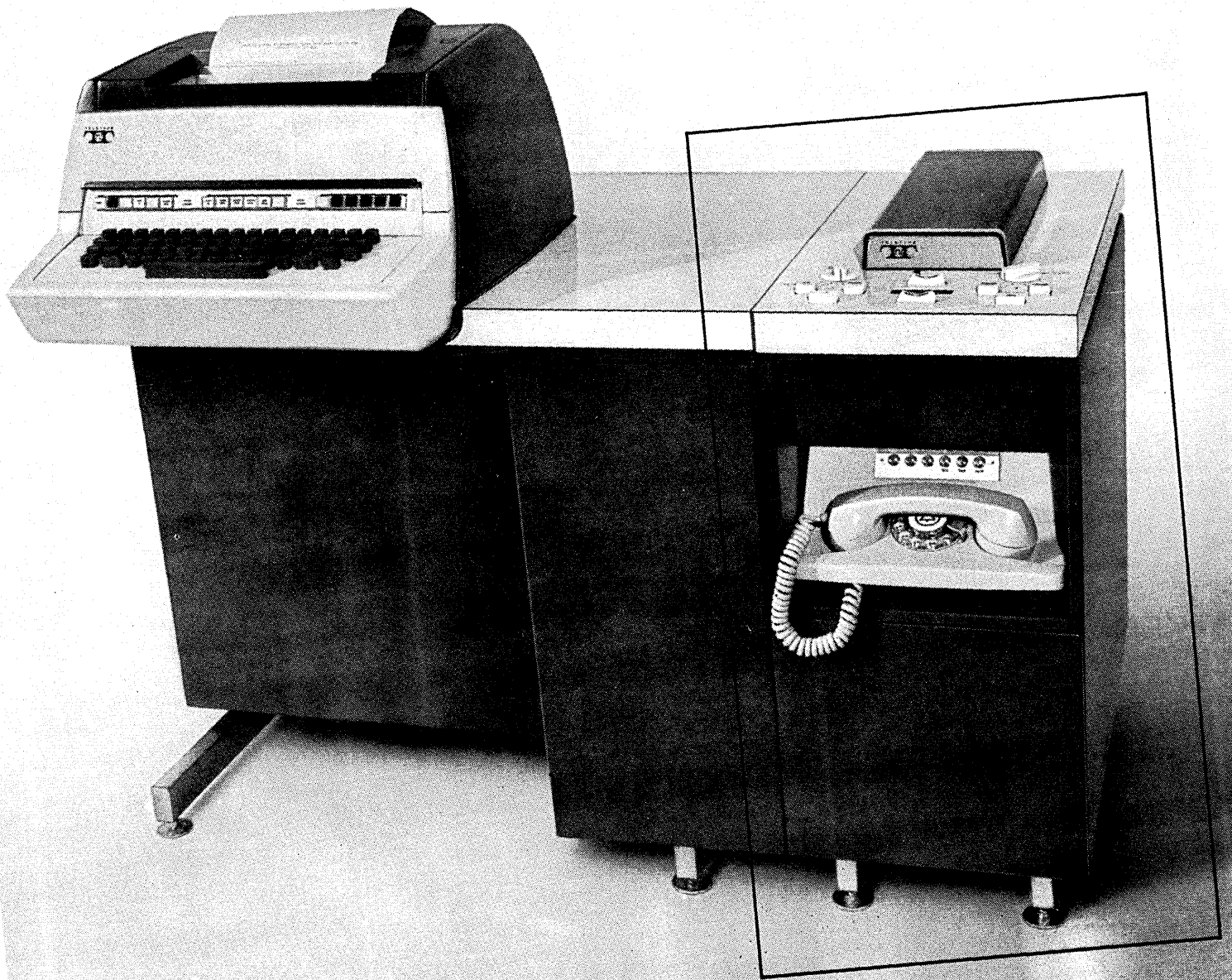
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The data that is sent and received is recorded on a compact cartridge that has a capacity for 150,000 characters. And the tape is reusable once the information on it is no longer needed.

Besides communicating at high speeds, the terminal has a Forward/Reverse mechanism that can search for specific data on the tape at a rate of 4,000 characters per second.

And time-consuming correction procedures are cut to a minimum since individual lines or characters can be easily located and corrected within a message.

The terminal can be adjusted to answer calls automatically, too. Transmission can be sent and received over regular telephone lines (Data-Phone® service) or private line service.

Often at low-cost after-hour rates.

Call your local Bell Company Communications Consultant for information on how our Magnetic Tape Terminal can be implemented within your existing system without major redesign.

The American Telephone and Telegraph Company and your local Bell Company keep working to improve telephone communications.

This time by helping you communicate at speeds up to 1200 words per minute.



PERSPECTIVE

an interpretive review of significant developments

Small Business Computer Market Competitive but Promising

Management Assistance, Inc., which originated third-party leasing in the dp business, turned from insolvency to plunge feet first into the highly competitive small business computer market.

This is a market with a potential domestically for more than 200,000 units, according to an Auerbach Technology Evaluation Study released last month. Joseph Barsa, vice president and treasurer of MAI, sees it as a \$300 million market and says MAI's new subsidiary, Basic/Four Corp. of Anaheim, Calif., wants 2-3%.

Basic/Four in late June introduced a mini-based business computer system after only four and one-half months of development. The introduction followed by a month MAI's solution of its insolvency problems. The leasing company found itself in a negative equity position to the tune of \$28 million late last year after it wrote down \$32 million in technically obsolete equipment. Early this year the company tendered more than 70% of the principal of its debentures for exchange with a package of preferred and common stock, the first time, says Barsa, such action has been taken outside of bankruptcy court. The successful consummation of the exchange offer in late May converted \$45 million in debt to equity and

brought shareholders' equity to \$17 million.

Quick Return

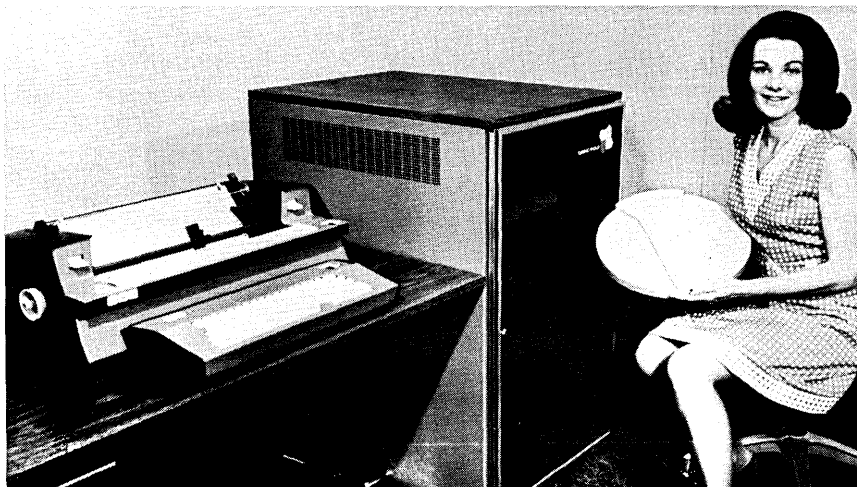
Barsa said development costs for the Basic/Four system were less than \$1 million, which could explain the company's confidence that it will make money with the system and will make it soon.

Somebody will make money in the small business computer market if the Auerbach study is correct. It has the average annual sales growth rate in the field at approximately 22% during the next five years with a 25% market penetration by 1975.

The study also indicates that small business computers will experience a reduction in price of up to 25% in the five years coming up. At this writing at least one company, Clary Datacomp Systems, Inc., was contemplating a price cut. John Sessions, president, said prices on the Datacomp 404 would be reduced by 12-15% in July. Reasons given for the cut were "manufacturing efficiencies ... and staying with the trend."

Clary's 404 is a small part of a wide array of competition facing the new Basic/Four system, which uses a Microdata mini. There's also IBM's System/3. Honeywell, Victor Comp-tometer, and Litton are in there too.

SMALL BUSINESS MARKET: MAI subsidiary is latest to enter small business computer-market with Basic/Four system built around Microdata minicomputer.



Singer Friden is there with its System Ten, although one industry source hinted at troubles being encountered with this system and guessed at a grand total of six installations. Friden declined to release installation totals, calling them "proprietary at this time."

Four Models

Auerbach for its study defined a small business computer as "one that rents for under \$3000 per month in a typical configuration." Under this umbrella prices vary widely. The System/3 goes for from \$2000 to \$2400 per month. System Ten in its simplest configuration leases for \$1400/month. The Datacomp 404's lease range prior to the reduction was \$500 to \$2000. Basic/Four leases will run from \$550 to more than \$1000.

Of the large number of companies competing in the market, says the Auerbach report, "only a few actually have the necessary marketing resources to become significant factors in the industry." Basic/Four might just have something going for them here. They have a built-in international sales force through MAI as well as a ready-made international service network through another MAI subsidiary, Sorbus.

Prices Vary

The Basic/Four system is available in four models ranging from a single-terminal disc system for processing one job at a time to multiple-terminal systems capable of handling several users with different applications. A minimum system includes an accounting machine terminal, a cpu, and a fixed and removable cartridge disc memory with a minimum storage capacity of 2.1 million characters. The computer is programmed in Business Basic, its proprietary extension of Dartmouth Basic.

The company said it had firm orders for two systems even before the Los Angeles unveiling in June, an unveiling preceded by a two-week series of teaser ads saying "Basic/Four is Coming" and "What is Basic/Four?"

The unveiling itself, a two-day show for prospective customers, produced requests for proposal from 100 companies, according to P. C. Davy, vice president of operations.

Like most of its competitors, Basic/Four is going primarily after new

users and will have to overcome competition from alternatives such as service bureaus and accounting machines, as well as the continuing economic constraints on the small user. But maybe they can do it.

—Edith Myers

"The Wired City" May Develop Before 1984

Remote surveillance of city streets to reduce crime and on-line polling of viewers to learn their product and political preferences are two of several pilot projects recommended by a panel of the National Academy of Engineering in a recent report written for a consortium of federal agencies. Entitled "Communications Technology for Urban Improvement," the report is aimed at showing how "modern communications technology, thoughtfully applied," can alleviate current urban problems, especially human overcrowding. The panel was chaired by Peter Goldmark, president of CBS Laboratories, and included representatives of communication carriers, system manufacturers, aerospace firms, and universities.

Most of the ideas suggested by the panel rely at least partly on 20-channel CATV systems with limited two-way communications capability. "The feasibility of the technology has been demonstrated," says the report, and "... it is expected that hardware will be available in quantity in two years."

During the 1970s, interactive home terminals will become "technically possible," the NAE panel reported. One possible version would "take advantage of the television set and telephone ... already present in most homes." These devices could be interconnected with an acoustically coupled storage-display control device; messages from the user to the computer would be entered through the telephone handset, and data from remote computer files could be received via the acoustic coupler, then stored and converted to the proper format for display on the tv screen.

There are now "over 2,500 operating (CATV) systems, with about 5 million subscribers," says the report. "Twice that number of homes have cable television available to them ...

(It) is no longer an exclusively small town phenomenon. . . . The change of existing one-way CATV systems to feedback operation will occur, just as the growth of CATV is taking place, without further special encouragement."

A prime purpose of several pilot projects proposed by the group is to determine whether two-way CATV can reduce the costs of computer-assisted instruction substantially below current levels. The report implies that cable technology can reduce the charge to 40 cents per student hour — i.e., "10-50 times below the cost of current CAI systems."

A transportation pilot project recommended by the panel would provide mass transit riders with routing, scheduling, arrival time, and similar information, on-line. The queries would be input through a terminal adjacent to each transit stop. "The first step would be manually processed information accessed by telephone, but full implementation requires a computerized vehicle dispatching system with automatic vehicle location, 'passengers waiting,' and 'passengers boarding and leaving' inputs."

This project also includes an auto-

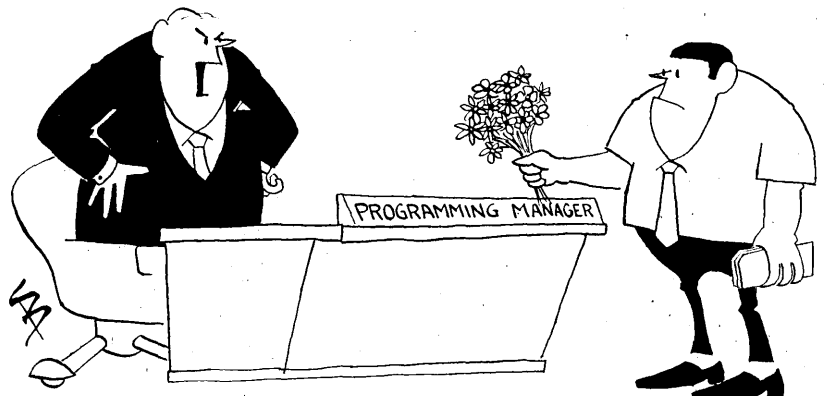
mated parking lot, controlled by remote sensors and a computer, where commuters could leave cars.

Other computer/communications systems are recommended to service urban health, pollution control, and general government information needs. The crime prevention pilot project proposes tv surveillance of a 2-square-mile area to determine "how well" an observer, watching a tv monitor, can distinguish among "justified, suspicious, and illegal actions." The report suggests mounting each camera at an intersection, and feeding the signals to a central monitor point by cable. The report refers to a study the panel made of New York City's 71st precinct, where it was found that all 58 miles of streets within the precinct could be monitored once every minute by 35 observers, located at precinct headquarters, using a total of 140 cameras.

The capital cost of a surveillance system for the 71st precinct was estimated at \$2.1 million — including \$15K for a computer and \$1.1 million for the cameras. Operating costs were estimated at \$1.013 million/year — mostly to pay 175 observers, each watching four monitors.

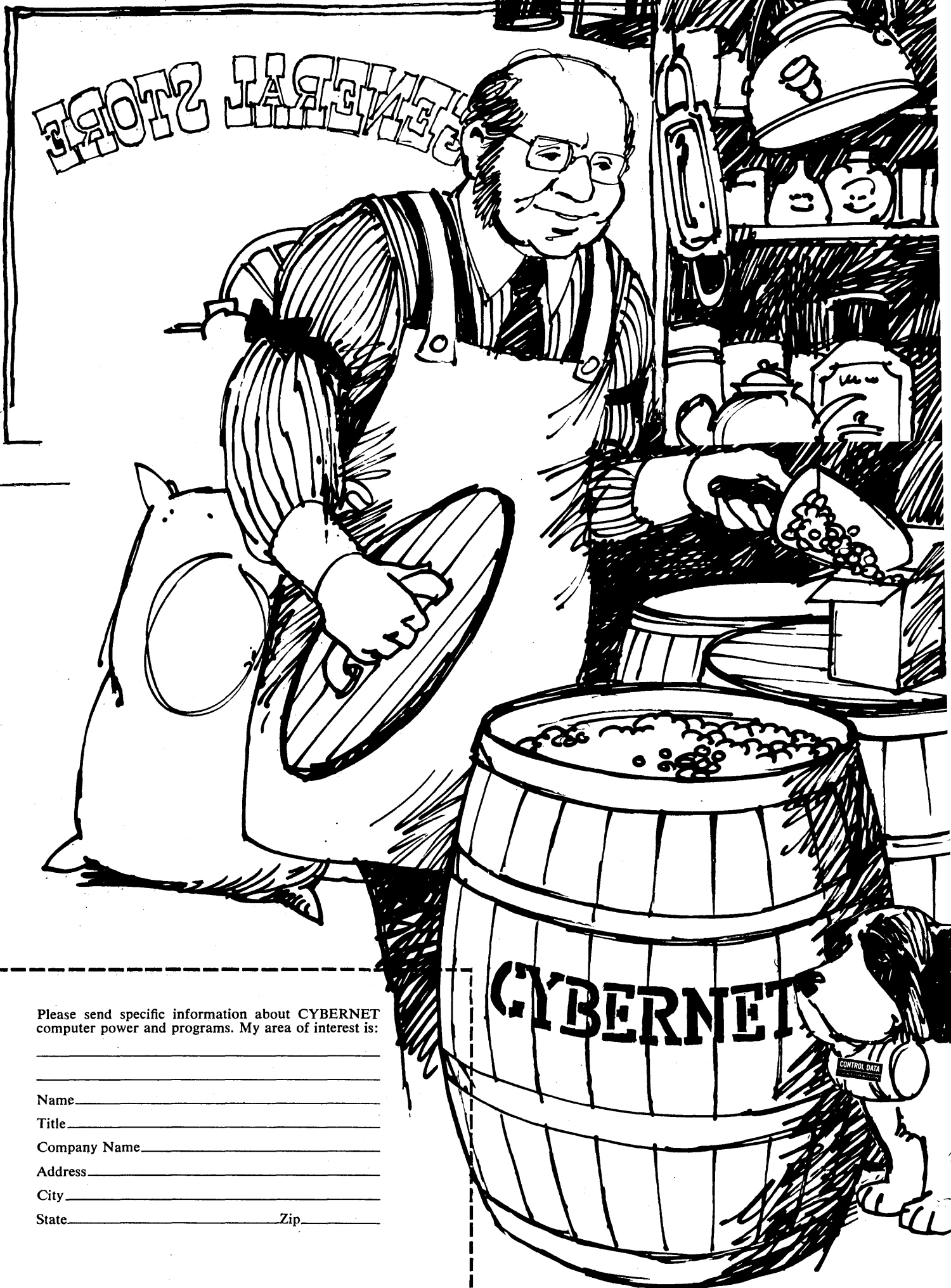
Connecticut was suggested as a likely place to set up all the pilot projects, largely because some exploratory work has been done there by state agencies. Other states would be encouraged to participate and to develop related demonstrations of their own. Cost estimates were supplied for many of the recommended projects, but little was said about where the money would come from.

—Phil Hirsch



"Dammit Hoskins, not another request for more debug time."

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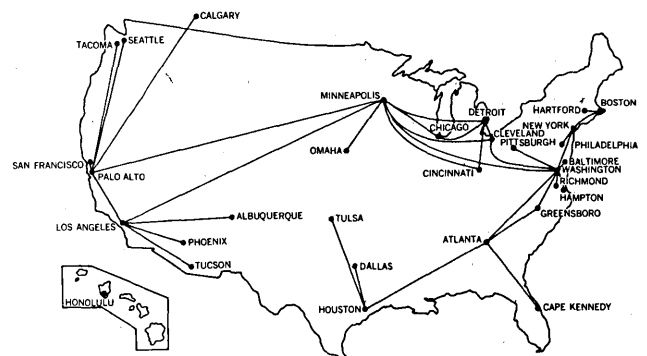
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NEWS SCENE

Tell Me Your Problems, Nixon Science Aide Asks

Computer professionals are invited by President Nixon's Science Advisor, Dr. Edward E. David, Jr., to tell him about unmet national problems related to information technology and to suggest possible solutions. David's invitation was made at a "Communication About Computers" meeting in Washington, sponsored by the Computer Science and Engineering Board, an arm of the National Academy of Sciences.

The computer is a "national resource," capable of attacking many current economic and social problems if it is "used efficiently as a catalyst for change in institutions," David said. A key problem is to overcome public fears, since "people can adapt to change when they themselves are controlling it." How the public can exercise this control effectively, after being informed, wasn't explained. Nor did David say anything about the need to present a balanced view of the computer's likely impact on society.

He briefly mentioned its potential for destroying personal privacy, but said that the "technology is in hand or nearly so" to protect civil rights in this area. "... (T)he problem is that system designers and their customers have not seen fit to utilize the available technology to protect people's privacy (because) ... of efficiency and costs." He seemed to believe, in other words, that public alarm over the computer as a destructive social force is largely groundless.

Most of David's speech was devoted to the economic consequences of computerization. He stressed its value as a tool for increasing productivity and reducing labor costs. Both of these alleged benefits, said David, would be particularly welcome in the service industries because it is here that most Americans are currently employed and where an even larger percentage of the nation's work force will earn its living in years to come. He mentioned the resistance of labor unions as one "impediment" to increased computerization in the service sector. David added that if produc-

tivity can be increased and labor costs reduced, it will alleviate another current economic problem — the nation's dwindling favorable trade balance.

The federal government is concerned about the antisocial aspects of technology, but despite defeat of the SST in Congress and the growth of what he called "environmental extremism," David said that "overall, I find no wave of antitechnology in the Executive or Legislative branches (of the federal government). In fact, quite the opposite. I find people in responsible positions very receptive to responsible proposals for advancing science and technology."

One example of this receptiveness is President Nixon's recent energy message to Congress, David said. "The solution he proposes is a pluralistic one based on R&D aimed at new technology ... This energy message was ... the first ... from a President to Congress whose thrust was an R&D effort aimed at solving a national problem. I hope and expect that it is but the first of many others ... and it seems clear to me that computers must play an important role in many of them."

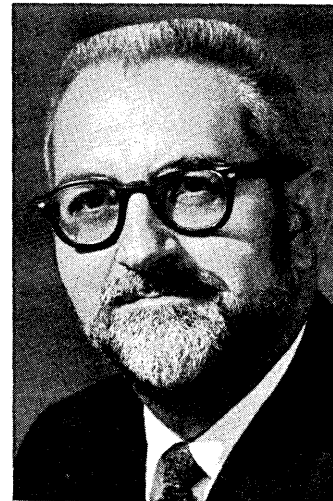
Dr. Walter Carlson, president of ACM, followed Dr. David to the lectern and described how his organization is working with other trade and professional groups to improve the computer's image. One project currently being discussed is a daytime tv game program based on the use of the computer. He expects "to see something moving forward on this (project) sometime this summer."

Another project involves the appointment of technically qualified "ombudsmen" in various parts of the country to answer complaints from people who feel they've been mistreated by computerized billing systems and similar applications of adpe.

Grosch, Davis Disagree on Value of NAS Board

Dr. Herbert R. J. Grosch, ex-IBM and ex-GE, seemed on the verge of becoming an ex-member of the National Bureau of Standards last month.

In June, he wrote a letter to the Computer Science and Engineering Board, a unit of the National Academy of Sciences, accusing its academic members of using the board to "further their own projects." He also charged that the board had accepted funding from the Defense Dept. "which, in return, specified classified work to support the DOD position on computer export restrictions." The



HERBERT R. J. GROSCH: NAS board members "are not needed and not wanted."

Commerce Dept. which favors increased computer exports, wasn't allowed to join the panel that worked on this project, added Grosch, and all panel meetings were closed to observers.

Soon after this letter was sent to the board, Dr. Grosch's boss, Dr. Ruth Davis, sent one to Dr. Philip Handler, director of National Academy of Sciences, in which she referred to Grosch's "unauthorized" comments. She called its Computer Science and Engineering Board "one of our strongest allies and most highly valued sources of advice and counsel." Dr. Davis added that "when I became director of the Center (for Computer Sciences and Technology), I moved immediately ... to remedy the deficient relationships that had previously existed between the center and the Computer Science and Engineering Board." Her predecessor in the director's job was Dr. Grosch.

Asked last month whether

Grosch's letter affected his position at the center (he's one of two senior research associates), Dr. Davis said "the utility of any individual to his organization is reduced when he does not share or endorse its views."

In his June letter, Grosch said the Computer Science and Engineering Board is "redundant" and "self-serving." He added that the board should not report to the National Academy of Sciences since "there is almost no science in 'computer science' and this is reflected in the obvious fact that there are almost no computer people in NAS, *nor are any wanted*" (Grosch's emphasis).

"I recommended to Allen Astin, then director of NBS, and to Fred Seitz, then president of NAS, that the board be disbanded . . . Astin sympathized but did not act. Seitz told me to my face that *nothing* (Grosch's emphasis) NAS did could possibly be corrupt. Or even unnecessary."

The letter, addressed primarily to 12 recently appointed members of the board, ended with the statement that: "You are not needed and you are not wanted."

CDC's Norris Bullish on Software Outlook

The growth rate for sales of computer hardware in the period of 1972-80 will be 10% annually, says Control Data Corp. chairman William C. Norris. He told the New York Society of Security Analysts only this summer that the software and services sector will grow at about 25% annually until it stabilizes at a size equal to about half of the hardware business, after which the two will grow together.

For the near term, 1971-72, however, the software business is still adjusting to unbundling.

Norris' talents as a soothsayer were questioned by one attendee who pointed out that two years ago Norris had predicted a 15% growth rate when speaking to the analysts. Norris replied that he hadn't foreseen the severity of the recession, the massive cutbacks in defense spending, and the collapse of Wall Street. Norris noted that CDC had been making significant inroads in sales to brokerages, but once Wall Street got in trouble, not



IBM'S TOP THREE: Thomas J. Watson, Jr. stepped down last June as chairman and chief executive of IBM, turning over that post to T. Vincent Learson, center, who has been IBM's president since 1966. Succeeding Learson is Frank T. Cary who was executive vice president. Watson, 57, returned to IBM this winter after suffering a heart attack in the fall. He cited medical reasons for the move. He still will be active in IBM decisions as chairman of the executive committee and member of the management review committee and the corporate office. Learson is 58 and Cary is 50.

only were no orders obtainable, but some equipment was actually returned to CDC.

The immediate prognosis for CDC appears guardedly optimistic, with a small profit from computer operations anticipated this year, and "hopefully" further improvement next year, Norris said. And Commercial Credit Corp. is continuing the trend of the last two years of annual earnings increases in excess of 20%.

There's apparently even a possibility of an out-of-court settlement with IBM. Though Norris wouldn't comment directly, citing a lawyer's axiom that "if you have a good case, keep quiet," he did say the judge often points out to the contestants that there's a settlement room down the hall.

Was COM a Victim of Overreaction?

The computer-output microfilm business has recently fallen from favor, largely as a result of reaction to over-optimistic predictions in recent years, which probably couldn't have been satisfied even if there hadn't been a recession. The National Microfilm Association itself was forced to admit COM projections had been too high, and an article in the financial paper *Barron's* went so far as to suggest that the trend to on-line systems

would cause COM to be by-passed in the future.

But overoptimism about COM may have been followed by overreaction, if we accept the conclusions of a Quantum Science Corp. report and conference on the microfilm industry presented in New York in June. Entitled "Search For an Image," the Quantum study forecasts a bright future for COM in the near term, with annual sales growth of 40% through 1975, amounting to \$25 million this year and \$67 million by 1975. This growth will also give COM a greater slice of the entire microfilm hardware market, widening from 18% this year to 26% by '75.

While Quantum recognizes that COM sales did drop somewhat as a result of the recession, it claims that units which were already installed remained in use, so that actual *usage* of COM continued to increase.

By 1975, however, market saturation will be approaching, since more than 50% of the major edp users — those with over \$50,000 monthly edp rental bills — will have COM systems installed, and few users require more than one machine. By then some 4,000 COM units will be installed, as opposed to perhaps 650-700 at present. Prices of COM units will also decline, starting around \$25,000 and averaging \$35,000, as opposed to \$30,000 and \$60,000, respectively, today. But that's four years away.

Midwest Exchange Enters On-Line Service Field

The Midwest Stock Exchange is asserting itself through an on-line service called Signet 80 which automatically handles orders from a brokerage to a stock exchange or OTC trading desk and also captures order trade data and automatically feeds it to a back office accounting system.

The service is being provided by the exchange's subsidiary, the Midwest Stock Exchange Service Corp. The MSEC had previously provided computer processing to brokerages primarily in batch mode.

The service is unique in that it's being provided by a nonprofit company and orders may be handled for all listed and NASDAQ securities between any U.S. or Canadian broker and any major stock exchange.

According to MSE president Michael E. Tobin, Signet 80 very closely approaches the concept of a "locked-



SIGNET 80: Brokers can access information on customers and their orders with crt terminal. Confirmations of orders are printed upon execution and mailed to customers 24 hours sooner than with conventional methods, speeding cash flow.

in trade." Trading is accomplished through crt terminals on the trading floors of the exchanges, which receive orders and transmit execution reports to and from terminals at the brokerages. When a transaction is completed, a mailable confirmation is printed out so it may be immediately sent to the customer.

The system also provides retrieval of information, such as data on individual customer accounts, which may be accessed by a registered representative. Reports on the status of

orders may also be obtained, listed by security, by branch, or all orders for a specific security within the firm. Access to this information is controlled, however; each user firm specifies who can receive what type of data on a "need to know" basis.

In addition, Signet 80 beginning this month will provide message processing between various offices of a brokerage, making it ideal for this type of firm. It is not intended to serve very large firms, however; nor is it aimed at the smallest brokerages.

The hardware used includes two 360/50s for back office accounting and two 360/40s for communications. Complete redundancy is provided. Terminals have been provided by Computer Communications, Inc., which also did software work.

Prices to user firms are \$650-750 per month per terminal for a "basic" amount of traffic. Beyond a certain level of use, the charges are on a per-message basis. The MSEC estimates it will have to have about 100 terminals in use to break even on Signet 80.

No News Can Be Good News Maybe?

There's new money and new muscle in Remote Computing Corp. of Palo Alto and Los Angeles, which early last month was promising a "good news announcement soon" to spell it all out.

One thing was clear at this writing. The company has a new chairman and chief executive officer in the person of Charles G. Calderaro, formerly president of URS Data Sciences and executive vice president of URS Systems Corp. URS Systems had tentatively agreed to acquire Remote back in March of 1970, getting an option to acquire the time-sharing company on March 1 of this year with the price dependent on Remote's earnings. On March 1, URS was to have had a choice between converting an investment in Remote into stock or debentures.

Which choice they made had not, at press time, been made clear. Don Cravitz, Remote's vice president and manager of the Los Angeles branch, would say only that URS now has a 19% ownership, adding the promise

of the forthcoming good news announcement.

Calderaro, with his appointment, announced the "infusion of new capital into RCC with additional investment on the part of RCC investors and myself."

Joel Johnson, president since 1970, continues in that office, functioning as chief operating officer. The time-sharing firm has said it became profitable last November.

With Broader Aims, New Group Replaces CPMA

Renamed and refinanced, what used to be called the Computer Peripheral Manufacturers Association — now known as the Association for a Competitive Data Processing Industry — was busily looking for new executive talent last month.

The search was headed by the association's new board chairman, Jack McDonnell, regional manager in Washington, D.C., for Information Storage Systems of San Francisco. McDonnell said the association's founder and president, Richard Caveney, will remain with the association; but he indicated its enlarged role requires a division of labor.

At press time in late June, five candidates were being winnowed from a list of 15 prospects. Soon afterward, the association's board was scheduled to choose the new man from these five finalists.

CPMA became ACDPI at a recent meeting in Denver, where the association's dues structure was changed and members agreed to pay special assessments for special projects. Companies grossing below \$1 million per year in sales now pay dues of \$500/year, and those selling \$1-5 million annually pay \$1500. The tab increases to a maximum of \$10K/year for companies selling more than \$25 million/year.

McDonnell estimated that ACDPI's revenue will be "on the order of" five times greater than CPMA's, which was based on a flat \$1500/year fee. He said the association currently has "about 20" dues-paying members. New members are being solicited, particularly software houses, data communication, and leasing compa-

nies. ACDPI is also cultivating amalgamation with like-minded trade associations: the Association of Independent Software Companies, Computer Lessors Association, and Data Communications Association were mentioned specifically.

CPMA's efforts to reduce IBM's dominance, make federal system procurements more competitive, and loosen Ma Bell's stranglehold on communication terminals are being accelerated by ACDPI, McDonnell indicated. A meeting between association officials and Pentagon planners, aimed at "restructuring" the much-delayed but still-active procurement of computers for the World Wide Military Command and Control System (Wimmix), was scheduled for early last month. Other ACDPI targets include: DOD policies which allow classified dp systems to be replaced/upgraded on a sole-source basis, recent changes in the federal supply schedule which enable the feds to purchase already-leased IBM peripherals at bargain-basement prices, and AT&T's refusal to let independent modem makers build protective connecting arrangements for users of foreign attachments.

If at First You Don't Succeed . . .

A phototypesetting machine which created a big stir when it was introduced back in early '68 but never made it big in the market place has, in a sense, reappeared with a new face, a new name, a new peddler, and a much lower price tag.

The original was the IBM 2680, produced to IBM specs by Alphanumeric, Inc., and sold by IBM, as nearly as can be determined, only to Alphanumeric for its phototypesetting service bureaus here and in France and Japan and to an outfit called Alphatext in Canada. Its successor is the Photon 7000, produced by Autologic, Inc., for Photon Inc. of Wilmington, Mass. Autologic, of Chatsworth, Calif., used to be the equipment arm of Alphanumeric and was the group that built the 2680. Last April controlling interest (60%) in Autologic was sold to Volt Information Services which earlier had acquired Alphanu-

meric's service centers.

Autologic shipped the first production model of the system to Photon last month. Photon has the exclusive marketing rights to the phototypesetter and according to Henry Bechard, president of Autologic, is committed to "enough units to keep us busy through the middle of next year." Autologic is scheduled to begin producing one per month in September and to work up to a production rate of four per month by the end of 1972.

The 7000 has a speed of 6,000 characters per second and produces type in 20 typefaces from 4 to 72 points high with a line length up to 70 picas. It incorporates a Datamate minicomputer and will accept either paper tape or magnetic tape input. Optional attachments available in October will include a microfilm roll camera, either 16 or 35mm, and a scanner which will accept continuous tone prints and produce a halftone or a line drawing. Prices range from \$125K to \$195K, with the latter price including all options. This compares to a \$387K price tag for the 2680.

Witter to Complete Back Office System in August

The "back office crush" that crippled operations of securities brokerage houses in 1968 and 1969 showed an urgent need for automated systems. But in the three years that brokers have been automating, few have been able to come up with one that did everything.

Wall Street, said one analyst, is a large, legally complex and manually involved system that doesn't lend itself to machine operations and where so many brokers operate differently.

One total system that seems headed for success was announced in 1970 by Informatics, Inc., the Canoga Park software company (see April 1970, p. 109). Called New Operations System (NOS), it was developed for Dean Witter & Co., Inc., the big brokerage house which has been installing the system in its New York office since last October.

The final two modules of the nine-module system will be in operation by the end of August. These will provide

the broker with a system for margin processing. This involves updating customer books and determining if the transactions adhere to rules of the various regulating agencies. Informatics said margin processing is divided into two phases, each of them requiring 256K of memory on the .360/50 used by Dean Witter.

The entire package will be used to automatically compute commissions, taxes, and fees; prepare confirmations; update the customer's account; and store the transactions for subsequent automatic processing. This would include receipt/delivery, bookkeeping, transfers, stock records, dividends, and statements. It's been under development three years at a cost of more than \$3 million.

Although being used with Witter's mod 50, the NOS, which is written in ANSI COBOL, can be used on mod 40s with 256K and also be adapted for use on computers of other manufacturers. Informatics said it has arranged with Witter to market the system to other brokerage houses on a turnkey basis at a basic price of \$500,000.

What IBM Has Put Asunder

IBM's systems engineers (SEs) once more were a familiar sight at user installations this summer as the big company quietly rebundled some software services.

Although it did not make a public announcement, IBM in June instructed its salesmen to advise users that SEs can now "assist customers in resolving defects in program products with Programming Service Classification E." This primarily involves for-fee application programs.

The no-charge rule also applies to field engineer service calls on what IBM calls class "A" program products, which include compilers. The ruling is: no charge on calls "resulting from operator error or calls associated with the unaltered portion of the program when no defect is identified."

Competing software companies saw no immediate threat because the rebundling applies almost exclusively to products available only from IBM.

Ancient Computer Frees Firm of Modern Plight

In an industry that has thrived on a never-ending barrage of new announcements, most of which have ridden on the red ink of the firms making them, Computer Property Corp. of New York has gone the other way: It's been marketing the Monrobot XI — a second-generation computer that's been with us more than a decade — and it has reported profits consistently since it was formed four years ago. Although the firm emphasizes a services business, CPC has actually made most of its money from hardware sales and leases. Monrobots account for about 40% of revenues.

The firm has pursued specialized markets, with emphasis on the banking, brokerage, construction, fuel oil, and insurance industries. By selling hardware-software systems which include a Monrobot computer, CPC claims it often avoids the issue of hardware entirely. They simply sell a solution to a problem. Other activities of the firm include some third-generation leasing and the operation of two subsidiaries, List Management, Inc., which handles business mailing lists, and Systems Design, Inc., which provides programming and systems design work. The firm claims both subsidiaries were profitable last year.

At its founding, CPC acquired the Monrobot operation from the Monroe subsidiary of Litton Industries. Monroe had not profited from the Monrobots, but CPC did. The machines themselves seem capable of lasting indefinitely, although the drum memory does wear out. That only costs about \$250 to replace, however. And the industrial design of the original Monrobot XI was unusually advanced for the time (1959); in fact, it was designed by one Richard Hollerith, grandson of the man of punch card fame.

Still, the XI has limited peripherals capability and can't handle very fast I/O. This prompted CPC to develop a "new" Monrobot, announced last winter as the CPC-12 (the XI itself has been dubbed "CPC-11"). They say improvements realize about a 50% increase in throughput. The printer doubles printing speed from about 11 to 22 cps.

Monrobots store either 1 or 2K 32-

bit words. They're priced from \$9,500 to about \$17,000 for the XI, and \$15-30,000 for the CPC-12. Price variations depend not only on peripherals, of course, but upon the specific applications software included. The Monrobots are programmed in a low-level language ("not even a true assembler") and user programming is not prevalent, nor is it encouraged. Instead, the machines are sold including software that is custom tailored to user needs, within the limited marketing sectors pursued by CPC.

There are estimated to be about 500 Monrobots installed today, of which about 125 are leased by CPC and another 80 sold by the firm. But the machines cannot last forever, and soon CPC may be forced to use another vendor's minicomputer, largely eliminating profits from hardware sales. When that day comes, CPC will have to make money almost solely from software and services.

NEWS BRIEFS

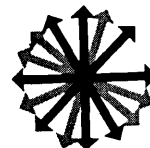
CAI Made Easy

A computer-assisted instruction (CAI) system for use by teachers without programming ability has been introduced by CBIS, a one-year-old Woodland Hills, Calif., company. Kenneth Lantz, an associate in the firm, said its CBIS learn system "drastically reduces the need for thinking in terms of algorithms," a need he says is a constraint in most CAI systems currently available. An instructor enters course identification and material interactively, and he can define the sequence in which material is made available to students. The system is available on Scientific Time Sharing Corp.'s APL Plus network for a \$150 initiation fee to CBIS and \$12 per terminal hour and \$10 per month per work space to STSC. It also can be purchased for \$1500 a run on a user's own 360/40 (and up), with core requirement varying with the number of users.

SHORTLINES

A computer "supermarket" has been opened in Arlington, Mass., by PHI

Computer Services, Inc., with the official name of PHI Management Services Div. and the aim of providing "almost all common business data processing services from daily accounts receivable to complete management of a client's computer center." ... Penril Data Communications, Inc., Rockville, Md., licensed Burroughs Corp. to manufacture and market a data terminal for translating credit card characters for telephone line transmission ... Three Ohio divisions of May Co. will install TRW Data Systems' System 4000 on-line credit authorization system ... Center for Communications Management, Ramsey, N.J., is offering a new service it calls ALIRT (Advance Look into Important Rate and Tariff changes) which informs users of rate and policy changes filed with the FCC on a selective interest basis ... Leasepac Corp., Cleveland, said it will offer IBM's 3336 disc pack on which deliveries are scheduled to begin this month on either full-payout or conventional leases ... Establishment of DCL Inc., a holding company for Diebold Computer Leasing, Inc., was approved by the firm's shareholders ... SEACO Computer-Display Inc., Garland, Texas, has acquired patent and design rights to a microfiche camera developed by Information Sciences Inc. and Walter Renold ... PRC Information Sciences Co. received a contract from the state of Florida to design and implement an automated and consolidated state retirement accounting system ... In the District of Columbia an IBM 360/40 is helping to select jurors, prepare juror summonses, keep juror records, and produce court-required reports in less than five hours a month ... Edutronics Systems International, Inc., has a new lesson module for its Programming Concepts series. Called Elements of Program Testing, it includes a film lesson and a viewer's guide containing a lesson preview, lesson outline, suggested procedures, and self-tests and is suggested for programmers and systems analysts ... Data Electronics Corp., Burlington, Mass., said it has completed development of its "Man-machine" general-purpose keyboard and is ready to mass produce. The firm signed a lease to increase its plant space 75% for that purpose. ■



Microcomputer

The P 602 microcomputer operates in two modes: Manually, it's an electronic calculator; while in program mode, it's a digital computer. The 602 has 16 registers, a ROM with MOS circuitry, and can be connected to a magnetic tape cartridge, paper tape equipment, etc. The price is \$3980. OLIVETTI CORP. OF AMERICA, New York, N.Y. For information:

CIRCLE 515 ON READER CARD



Portable Tape Drive

The model 1200 is a battery-powered, write-only unit for recording 7-track IBM-compatible tape at 200 bpi. The speed can be specified between 1-50 increments/second limits, and battery current is drawn only while actually recording. Single-unit price of the standard 1200 is \$3125. Parity and gap generation electronics are optional. KENNEDY CO., Altadena, Calif. For information:

CIRCLE 506 ON READER CARD

Oem Tape Transport

The sc 1037 is a vacuum column, single-capstan tape transport featuring IBM-compatible, 9-channel read/write operation at densities up to 1600 bpi and bidirectional speeds of 20-45 ips. In quantities of 100 it is priced at \$2850. Delivery requires six to eight weeks ARO. POTTER INSTRUMENT CO., Melville, N.Y. For information:

CIRCLE 520 ON READER CARD

Paper Tape Winder

Many users of paper tape equipment might find it convenient to have this hand-held tape winder. A 4-inch roll of paper tape can be wound in 5 seconds, it is claimed. The device is constructed of Lexan to survive being dropped and is priced at \$42.50 including the electric motor. LOGIC ASSOCIATES, Hanover, N.H. For information:

CIRCLE 511 ON READER CARD

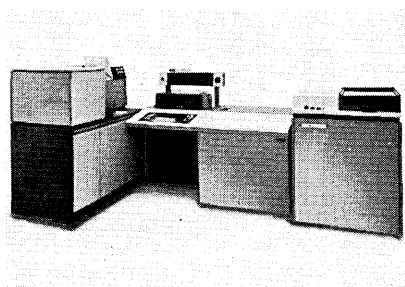
On-line POS

The Uni-Tote series 300 point-of-sale system features the ability to interface to any tag reading system and performs automatic credit authorization and on-line data collection. A visual indicator steps the operator through the necessary operations. The basic price is \$2800 per unit. GENERAL INSTRUMENT CORP., New York, N.Y. For information:

CIRCLE 507 ON READER CARD

1130 Disc Storage

The ds12 storage system comprises a CalComp cd12 disc drive and integral controller. It provides 1130 users 10 megawords of storage on each disc pack, with over 2.5 megawords under monitor control at any given time. Information is accessed in 35 msec on the average. The ds12 system is said to be functionally in-



terchangeable and program compatible with all IBM 1130 disc systems using the Monitor-II operating system. The price is \$24K for the system, or it can be rented for \$600/month on one- to four-year contracts, with deliveries scheduled 60 days ARO. CALIFORNIA COMPUTER PRODUCTS, INC., Anaheim, Calif. For information:

CIRCLE 526 ON READER CARD

Cartridge Storage

The best features of the TP-1351 cartridge (Oct. 15, '70, p. 87) are said to have been retained in the TP-1372, which we take to mean the 3.7 kHz transfer rate. The TP-1372 is a double-cartridge model of the 1351, upping the maximum storage capacity to 512 kilobytes. Timing, byte assembly, and motion delays are handled by a new control unit. Normal operation of the TP-1372 is via the program interrupt feature, accessing one byte at a time. A software package is included in the price of \$3590, and interfaces are available for several mini and midcomputers. Deliveries are 60 days ARO. TENNECOMP SYSTEMS, INC., Oak Ridge, Tenn. For information:

CIRCLE 525 ON READER CARD

Crt Terminal

The model 440 DATA-SCREEN crt terminal is a plug-to-plug replacement for tty's and is priced at only \$1595 in quantities of 25. Featured are 72- or 80-character lines (switch selectable) with 24 lines displayed, automatic carriage return and automatic line feed, switch-selectable half- or full-duplex transmission at 110 or 300 baud, a built-in connector allowing interface to a model 33 tty for hard-copy printout, etc. The ASCII characters are shown as 5x7 dot matrix patterns using a standard tv monitor. Three tty interfaces are provided: EIA RS-232C, TTL logic levels, and 20ma current loop. Keyboards are optional, and the model 440 is available 30-60 days ARO. TEC, INC., Tucson, Ariz. For information:

CIRCLE 527 ON READER CARD

Disc Storage

A 2311-type moving-head disc pack system is offered buyers of the Nova minicomputer line. The capacity is over 3 million 16-bit words transferred at the rate of one word every 12.8 msec. The system consists of the controller and adapter (which can control up to four disc units) and the disc unit itself. The control device contains a sector-count register allowing up to 16 consecutive 256-word sectors to be transferred with one instruction. Communication during data transfer occurs with one disc at a time, but the control device allows all discs to seek simultaneously. The controller is priced at \$4K, the adapter \$6K, and the disc unit is \$13K. DATA GENERAL CORP., Southboro, Mass. For information:

CIRCLE 528 ON READER CARD

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Stand Alone

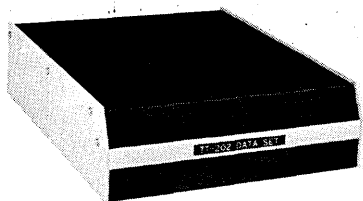
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TEL-TECH CORP.

In Canada: Canteltech, Ltd.

CIRCLE 16 ON READER CARD

Credit Terminal

The TV 300 credit authorization terminal can communicate with the computer centers of up to six credit card services. It will be leased at rates of \$15-40/month/terminal, depending on the number of credit cards and number of users. Deliveries begin in the fourth quarter of next year. BURROUGHS CORP., Detroit, Mich. For information:

CIRCLE 529 ON READER CARD



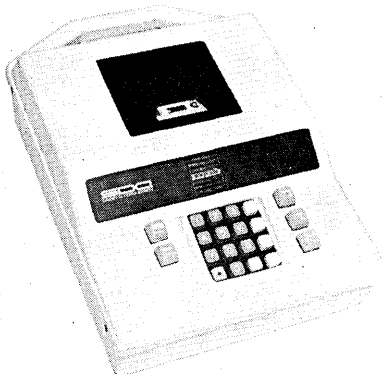
Crt Terminals

The series 4000 microprogrammable crt terminals are plug-compatible with IBM 2265 and 2741 units and the tty line. The asynchronous transmission rate ranges from 110-9600 baud, with synchronous rates up to 1 MHz. At present, three members comprise the family: the model 4200, priced at \$2800; the model 4300, which can be modified in the field for text editing, priced at \$3195; and the model 4700 with a \$4095 price tag. This unit combines dot and vector generation, curve tracing, and selec-

tive curve erasure with its character display capabilities.

All units can receive and transmit data by character, line, block, or page, and have 128 character ASCII sets and 14-inch displays. Screen capacities are 20 lines of 80 characters. Also featured are blinking, upper and lower case, field reverse, automatic scrolling, and character and line insert/delete. The series 4000 is available 90 days ARO. SUGARMAN LABORATORIES, INC., Great Neck, N.Y. For information:

CIRCLE 523 ON READER CARD



Portable Terminal

At 6½ pounds, the Porta-Station is a truly portable terminal. It includes a numeric keyboard, readout lights, and a Philips-type cassette. The rechargeable batteries last 8-10 hours in constant use. Prices are \$1200 for a write-only unit, \$1500 for read/write capability, plus \$300 extra for a Porta-Station with acoustic-coupled 40-cps transmission capability. SDA SYSTEMS, INC., New York, N.Y. For information:

CIRCLE 516 ON READER CARD

Port Selector

The model 440 M port selector provides switch-selection of either or both of two computers, enabling the operation of tandem cpu's on-line. Either cpu may be removed for maintenance or off-line use. Standard dial access control signal conventions of Western Electric 103 A/E are used, and line-port interfaces comply with EIA RS-232-C specs. Prices start at \$6500, and delivery is 30 days ARO. INFOTRON SYSTEMS CORP., Pennsauken, N.J. For information:

CIRCLE 517 ON READER CARD

Medium Key-to-Disc

A key-to-disc system that handles 9-20 terminals incorporates features of the vendor's large LC 720 system. The LC 700 outputs standard magnetic tape. Each terminal has a display panel indicating last character entered, plus instructions. Monthly rental is \$1050 for the controller and about \$100 per terminal. Delivery requires 90 days ARO. LOGIC CORP., Cherry Hill, N.J. For information:

CIRCLE 519 ON READER CARD

Arithmetic Processor

Here is a floating-point processor that can be attached to many of the Digital Equipment Corp. products, as well as Data General, Varian, and Hewlett-Packard offerings. When attached to a PDP-8, the PP-1-8 unit does floating-point calculations in 15 usec, with a total time of 23.5 usec including the PDP-8 overhead. Also part of the package is a software replacement for the DEC-08-YQ4B-PB floating-point routine. The price for a unit set up for the PDP-8, and including software and two-channel data-break multiplexor, is \$4950. Delivery is 30 days ARO. L-S COMPUTING CORP., Campbell, Calif. For information:

CIRCLE 512 ON READER CARD

PDP-8 Cassette

A cassette unit for use as a paper tape replacement on PDP-8 computers is being marketed by a new three-man firm for only \$535. The unit includes read and write programs in RIM or binary format which occupy the same core area as the PDP-8 binary loader. The device was developed as a by-product of the firm's PDP-8 system for use by fuel-oil dealers for accounting chores. The latter system sells for \$15K, but it is not yet available nationally. The cassette unit requires 30 days ARO for delivery. DIGITAL COMPUTER SYSTEMS, Brooklyn, N.Y. For information:

CIRCLE 530 ON READER CARD

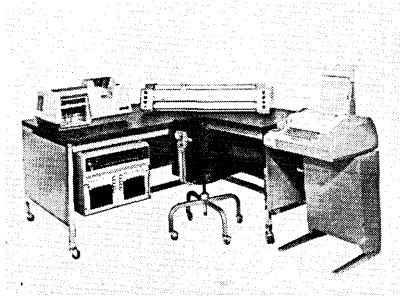
Tape Drives

Interfaces are available that allow the PI-1217/19 series of digital tape drives to be used with the Honeywell 316 and 516 computers; the Digital Equipment PDP-8, PDP-9, PDP-12, and PDP-15; and all Data General minicomputers. IBM-compatible tape can be written on the synchronous or asynchronous models at specified densities ranging from 200-1600 bpi. Speeds range from the standard 45 ips and 100 ips. Depending on electronics desired, end-user versions are priced around \$4K, with oem units dropping closer to \$3K. Delivery is 30-60 days ARO. PRECISION INSTRUMENT CO., Palo Alto, Calif. For information:

CIRCLE 510 ON READER CARD

Remote Batch Terminal

GEORGE is the name of a remote batch and data acquisition terminal intended for use by semiskilled operators. Emulation packages are available permitting GEORGE to function as a Univac 1004, CDC User 200, or IBM 2780 remote terminal when not doing engineering, scientific, and business processing using the appli-



cation library supplied. The basic 4K Nova minicomputer controller and communication interface package is priced at \$11,600. Options include plotters, card equipment, a tty, printer, etc. Delivery is 60-90 days ARO. APPLIED COMPUTER SYSTEMS, INC., Austin, Texas. For information:

CIRCLE 518 ON READER CARD

Program Storage

An incremental tape unit called the COMP-EX features 8-bit recording for keyboard, search, compare, and editing routines. No special software routines are necessary to use the COMP-EX with Data General, Hewlett-Packard, XDS, or IBM computers since the unit uses the paper tape driver subroutines of the host computer. The special 3½-inch tape reels are contained in a cartridge and provide up to 200,000 bytes of storage. Including necessary connections, the COMP-EX is priced at \$2982. DIGITAL RESOURCES CORP., Houston, Texas. For information:

CIRCLE 508 ON READER CARD

Graphics Terminal

The AGT 100 series of interactive graphic terminals succeed the current AGT line. The models 110, 130, and 150 are direct replacements for the 10, 30, and 50, respectively, with which they are program compatible. Performance improvements are up to 100%, it is claimed, and the digital processor now uses TTL integrated circuitry and MSI. Prices are \$98K, \$147K, and \$167K for the units with 8K memory. An additional 8K adds \$20K to the price. ADAGE, INC., Boston, Mass. For information:

CIRCLE 514 ON READER CARD

Tape Drives

Alternative tape drives to the IBM 2401-5 and -6 and the 2420-5 and -7 models have been introduced. The TM-20 is a self-threading drive available with 75, 100, 112.5, or 200 ips speed capabilities and packing densities of 800 and 1600 bpi. A TM-20 replacement for a 200-ips 2420-5 rents for \$670/month, including 24-hour maintenance, on a one-year contract. A similar contract for a 112.5-ips, dual-density 2401-5 replacement rents for \$590. Delivery is 60 days ARO. AMPEX CORP., Culver City, Calif. For information:

CIRCLE 509 ON READER CARD

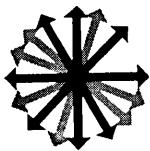
Cassette Recorder

The Execuport 415 cassette recorder connects to this manufacturer's Execuport 300 and serves as a storage unit for the portable terminal. Packaged in a 12 x 13 x 8-inch carrying case, the recorder uses Norelco-type cassettes. It transmits and receives data at 10, 15 or 30 cps depending

on the speed of the terminal unit. At 30 cps a 60-minute cassette will hold 50,000 characters of data. Controls for the 415 include rewind, record, stop, play/record, and forward. While in the play mode, the unit is controlled by two other start and stop switches which keep transmission synchronized with printer head movement. The 415 can be linked to

other terminals through an RS-232B interface. The Execuport 415 is priced at \$1495 and can be leased. Delivery is quoted at 30 days ARO. COMPUTER TRANSCIEVER SYSTEMS, INC., Paramus, N.J. For information:

CIRCLE 521 ON READER CARD



Program Maintenance

Imagine the increase in productivity and morale that might be realized if programming staffs were relieved of the strictly clerical chores accompanying program development that

PRODUCT SPOTLIGHT

account for upwards of 80% of their valuable time. The alternative to having programmers search through card decks to flag numerous changes—and perhaps keypunch the changes

themselves—would be to use a program like **TXTM**. Once the programmer's source deck is loaded onto a tape or disc file, a free-form language is used to describe subsequent changes. These changes may be in any order.

An example of what can be accomplished in a single run looks like this: reference material in two master files containing source and object programs, enter new material from a tape, apply corrections and new data from cards, create a new master file and copy it, generate a **SYSIN** containing records for compilation or execution, produce listings, and punch out

any number of card decks! **TXTM** contains a sort module, and since it can move fields and columns, it might be possible for an installation to reduce its complement of eam equipment substantially.

TXTM is written in **BAL** for operation under **DOS 360s** having at least 64K of memory. The program can be readied for os operation. It is priced at \$100/month, or \$1K/year. A free 30-day trial is offered, as is a three-year lease. **JOSEPH SIDER & ASSOC.**, Encino, Calif. For information:

CIRCLE 501 ON READER CARD

Municipal Programs

The **MUNIPAC** appropriation management system includes programs such as payroll and personnel, plus a module for generating cost vs. budget reports, accumulating labor, services, material, and other costs applicable to appropriations for analysis, projections, and status. It is intended for use by municipal governments and is written in **COBOL** for use on 64K 360/30 computers or equivalent. Different modules may be purchased separately, but generally the pricing starts at about \$35K. **BRADY-TOWER, INC.**, Encino, Calif. For information:

CIRCLE 502 ON READER CARD

XDS Business Programs

It's not too hard to see the reasoning behind the addition of a report program language (**RPG**) and a **SORT** package to the **Sigma 3**. So equipped, it becomes a good competitor to the **IBM System/3**, the **NCR Century 50**, and others and has the advantage of offering real-time computation concurrent with **ANSI FORTRAN**. The **SORT** program is scheduled to be available in the last quarter of this year, with the **RPG** package slated for early next year. **XDS** is bundled. **XEROX DATA SYSTEMS**, El Segundo, Calif. For information:

CIRCLE 504 ON READER CARD

Inventory/Billing

An order billing and inventory reporting package called **ORDER BILLING TECHNIQUE II** is a post-billing, batch order processing system for **NCR Century** series computers. It is intended primarily for distributors of heating, electrical, hardware, and plumbing supplies, but is also adaptable to distributors of apparel, piece goods, and notions. Manufacturers who have similar order-from-stock sales can also use the package for invoicing and inventory reporting. It is written in **NEAT/3** and requires 16K of memory. **NCR**, Dayton, Ohio. For information:

CIRCLE 503 ON READER CARD

Microfilm Software

Micro Fast is a **BAL** program that creates a report tape formatted to produce microfiche on any **Stromberg DatagraphiX Micromation Recorder** (4360, 4440, 4060, or 4070) equipped with the **Universal camera**.

Approximately 10-15K bytes of core is required, depending on how large the customer's index is. Features include single-pass reformatting, output buffer management, record formatting, title character generation, fiche index generation, automatic fiche break, automatic page advance,

carriage control character set selection, retrieval coordinates on each page, and carriage tape simulation. The price is \$1K and includes a user's manual. **NATIONAL MICROMATION, INC.**, Des Moines, Iowa. For information:

CIRCLE 505 ON READER CARD

Cross-assembler

The latest cross-assembler from a firm that appears to specialize in such products generates paper tape object programs for the **PDP-11** minicomputer from punched card source statements written for that computer. The cross-assembler is written 95% in **FORTRAN** and 5% in machine-dependent code, occupying typically 8K words on an **IBM 1130**. The mailout package is priced at \$1500, including a users manual, and is available now. **DECISION SCIENCE, INC.**, San Diego, Calif. For information:

CIRCLE 513 ON READER CARD

File Simulation

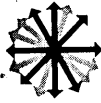
Sim File provides test data files for the checkout of program logic. Up to 4,096 records for up to three files can be generated in random, sequential, or field-dependent format. The price of \$500 includes the **COBOL** source program and data generator. **Sim File** operates under 360 dos. **MANAGEMENT DATA SERVICES**, New York, N.Y. For information:

CIRCLE 524 ON READER CARD

Cross-compiler

Using the **AED** language, this firm has developed a version of a **PL/I** compiler that generates code interpretable by the **Data General** minicomputer line. Called **PL/75**, the compiler has most of the features of **IBM's PL/I** language subset for **TOS** and **DOS** systems. **PL/75** runs under **OS** or **CP-67/CMS** and is priced at something under \$50K. Versions for other computers are also available. **SOFTECH**, Waltham, Mass. For information:

CIRCLE 522 ON READER CARD

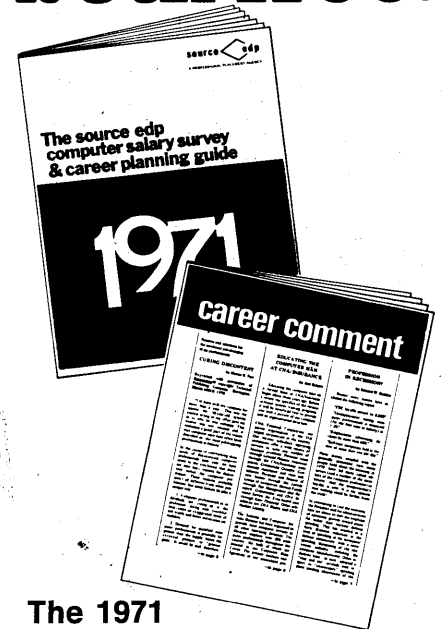


PEOPLE

Maybe commuting 32 miles from San Marino to Marina del Rey, Calif. (Nov. 15, p. 125) became too much, or maybe, as the official report has it, he felt he had done his job and his role was ended. Either way, **Herbert Hoover III** has resigned as president of Digitek, Inc., to pick up consulting activities he dropped when he was hired to reorganize the time-sharing firm early last year. His replacement, **John A. Green**, was a vice president of corporate development for Wells Fargo Corp., which has a 43% ownership of Digitek and an option to increase this to 49.9% . . . **Dr. Melvin Pirtle**, whose Berkeley Computer Corp. never quite made it with its big Model 500 time-sharing machine (May 15, p. 83), is still involved with a big computer. He's now manager, Illiac IV Project Office, at NASA's Aames Research Center, Moffet Field, Calif. . . . **William B. Patton**, most recently assistant to the U.S. group vp of marketing for HUS, has been appointed director of field marketing of Western operations. He succeeds **E. W. Green**, now president of the Computer Products Div. of Electronic Memories and Magnetics, Los Angeles . . . New directors at Advanced Memory Systems, Sunnyvale, Calif., are **Paul Bancroft III**, vp of Bessemer Securities Corp.; **David Bossen**, president of Measurex Corp.; and **James P. Hynes**, president of Standard Computer Corp. . . . Lockheed Electronics Co. executive vp **William A. Stevenson** has been appointed acting president of the firm. The company says that all five of its divisions are operating profitably, and no changes in management are contemplated. Former president **Gerard L. Seelig** left Lockheed to become gm of ITR's Semiconductor World Wide and executive assistant to the president . . . **John E. Hove**, former president of Dynasciences Corp., has replaced **Jack L. Maatsch** as chairman of Serendipity Inc., Sherman Oaks, Calif., following Maatsch's resignation . . . **H. Dean Toombs** has joined SEACO Computer-Display, Garland, Texas, com manufacturer, as executive vp. He comes from Texas Instruments, where most recently he was manager of technical development of the semiconductor circuits division . . . Ex-president and general manager of Fabri-Tek's

memory products division, **Richard J. Petschauer**, has been named group manager, advanced storage technology, at Univac's development center in Roseville, Minn. . . . **George J. Popp, Jr.**, assistant vp of Harris Trust & Savings Bank, Chicago, will serve for the next two years as president of the 500-member Univac Users Association . . . **Richard Pasternak**, who had been responsible for the design and engineering of Computer Development Corp.'s cd 200 minicomputer used in Eldorado Electrodata's small business systems, has joined his former customer as vp of the computer division . . . **Nelson R. Henry** has moved from Eaton Corp.'s Lock & Hardware Div. to its Security Systems operations as group vice president . . . **John R. Bermingham**, a vp at Irving Trust Co., New York, has been named head of the bank's Operational Services Div., which is responsible for operating functions that include data processing, securities services, banking records, and the clearance and transfer services . . . At White Front, a Los Angeles-based department store chain, **William Kavan** has become manager of a new department called Management Information Systems, where he will supervise data processing, systems and procedures, and office services . . . **John C. Roy** is the new vp of sales at Entrex Inc., Burlington, Mass., data entry company. Most recently Roy was with NGP Associates of Riverside, Conn., and before then, vp of marketing for cuc . . . **Robert K. Draving** has been appointed vp for engineering of the Digitronics Div. of Digitronics Corp. He is responsible for all engineering development at Digitronics and is directing new developments at the Data Handling Corp., Santa Ana, Calif. Digitronics, Albertson, N.Y., is the North American Philips company that has just announced a non-Philips-type cassette . . . **Joseph A. Carbone**, former vp of administration at Xerox Data Systems, has joined Computer Machinery Corp., Los Angeles, as vp, general counsel, and secretary . . . **William D. Mellin**, who was with Planning Research for eight years prior to 1970, is now secretary, treasurer, and a director of a new Tustin, Calif., company called Auto-Zip, Inc. Auto-Zip is planning to provide computerized inventory control, parts interchange, and recycled auto part location services to individual firms in the automobile dismantling industry. ■

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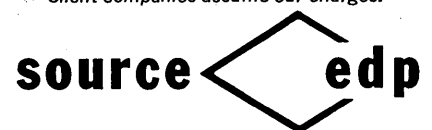
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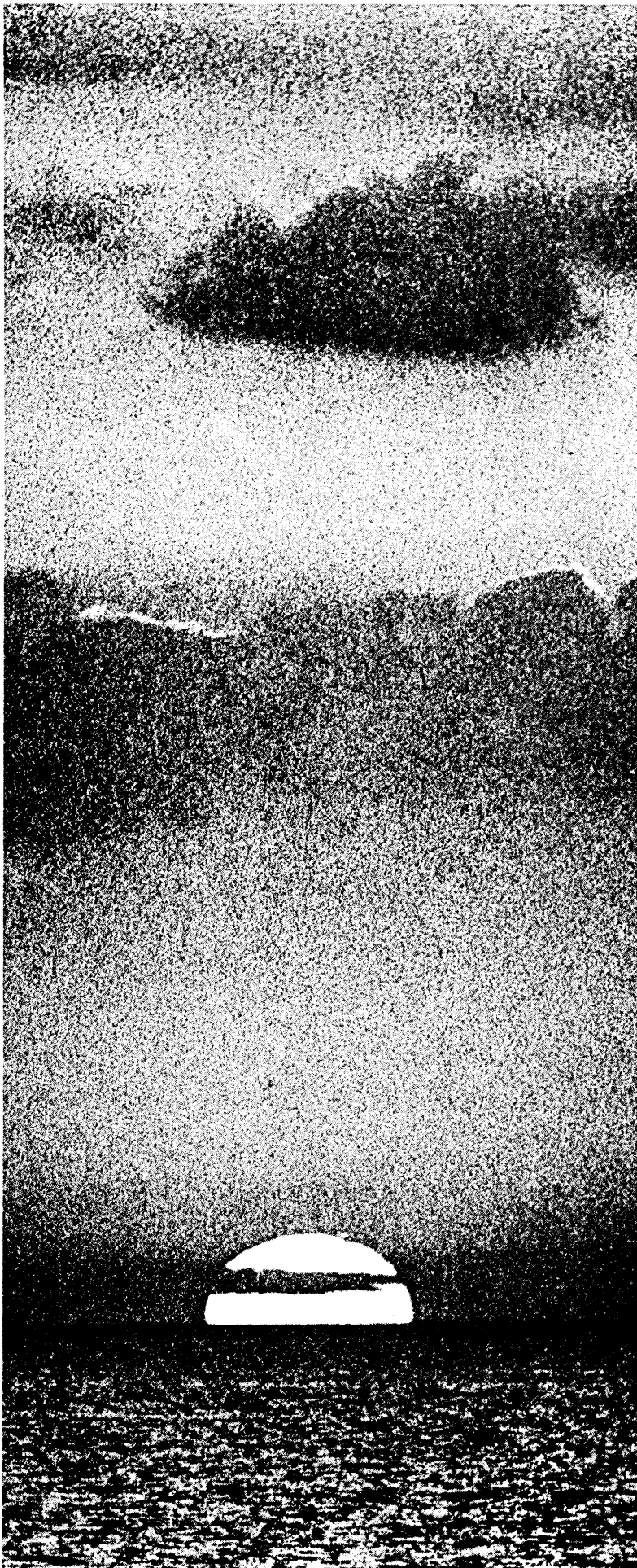
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WASHINGTON REPORT

MARKETING SCORES FOR MULDIVO, PHILIPS

Two important marketing advances have been made in the computer-communications sector in Europe. One affects the developing company, Muldivo Computers, and the other, the giant Philips group of Holland.

Muldivo has won a contract to supply a joint message switching system to Esso Petroleum and Esso Europe. It will be based on two of Muldivo's Elbit 100 processors backed by Sperry drums and tapes. They will provide message switching between The Hague, Paris, Rome, Copenhagen, Brussels, London, and Hamburg, and also between Europe and the U.S.

A Philips subsidiary, Telephone Manufacturing Co., has received a near \$10 million contract for computer control of the British Post Office's international telegram traffic.

FARRINGTON LIQUIDATES IN EUROPE

A subsidiary of the Canadian company, Rapid Data Systems and Equipment, has paid \$2 million for the addressing, embossing, and data writing machines operations of the insolvent European end of Farrington Manufacturing. The Farrington group's money problems included troubles with some special hardware developments in Europe and with an abortive investment involving a franchise in France for the Mitsubishi Melcom visible record machine. Stretched resources finally collapsed when one of the major banks called in an overdraft loan. Since the Farrington decision to liquidate, Mitsubishi has opened in Europe with a new company, Melcom System Ltd. in the U.K.

IBM PERIPHERAL PRICES HOLDING IN EUROPE

IBM has yet to cut its peripheral prices in Europe. But major independents are said to be ready with plans for service-price structures which would give them a marketing edge should IBM cuts occur.

ICL GETS OK FOR RUSSIAN SALE

Authorization for ICL to supply a \$12-million system to Russia for the Institute of High Energy Physics at Serpukhov has come through after 19 months from the Cocom committee controlling the export of strategic goods to the Eastern bloc. Cocom, the regulatory body of the NATO countries, had held up the delivery on the veto of U.S. representatives. The Soviets wanted two ICL 1906 A and three smaller 1903 A processors for on-line computation with bubble chambers and particle track analysis of films. The order allegedly was delayed on grounds the machine could be strategically useful for jobs other than those for which it was sold.

MORE U.S. TERMINALS FOR EUROPE

General Telephone and Electronics has commissioned Datatech Industries to make and sell its keyboard devices for on-line work and off-line data preparation in Europe. Tracor Data Systems, Austin, Texas, has negotiated with Racal-Thermionic for European marketing of its keyboard-printer terminal.

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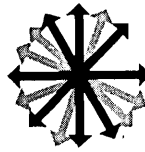
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BOOKS



Microprogramming: Principles and Practices, by Samir S. Husson. Prentice-Hall, 1970. 614 pp. \$16.95.

This book is the first major work on microprogramming, and is obviously destined to become a classic. Mr. Husson is from IBM, is an ACM Lecturer of the Year (1970-71), and is visiting associate professor of computer sciences at Brooklyn Polytechnic Institute.

The reader may need credentials just as admirable, for the subject turns out to be very heady stuff, with much of the book consisting of excruciatingly detailed charts and diagrams documenting the internal hows and whys of System/360 models 40 and 50, RCA Spectra 70/45, and Honeywell 4200. The charts and diagrams are profuse in number, professionally executed, and highly technical, like most of the book. A strong hardware background will help make the reader comfortable, but the book should be of interest to some systems programmers as well.

Husson's early chapters provide considerable information about the background of microprogramming, beginning in 1951 with M. V. Wilkes' conceptualization of the



technique as a means of providing an orderly way to design the control section of a computer. The reader is introduced to considerations of cost and performance tradeoffs and other advantages and disadvantages.

From the programming standpoint, many of the remarks in the chapter on Microprogramming Applications make for interesting speculation:

"Almost all existing general purpose computers that are used for commercial processing can profit considerably from the addition of a few macros for bit and byte manipulation in microprogramming. Similarly, in scientific applications, additional instructions such as matrix operations and inverse divide would

reduce compile time and would lead to a fuller realization of the computer potential. In the area of system monitors, compilers, interrupt handling, schedulers, interpreters, resource allocation schemes, etc., where these routines are used over and over, and where no changes are expected to be made, *it is imperative that they be seriously considered for microprogramming*" (italics supplied by reviewer). Husson quotes fellow IBMer Hans Jean's feasibility study to the effect that most mathematical operations would benefit little from microprogramming, but table search could be sped up by a factor of at least 10, and compilers and their object programs could benefit greatly from the proper microprogramming.

Of considerable related interest is Husson's description of the specially modified model 50 for Allen-Babcock Computing, Inc. This modification consisted of 17 additional op codes for handling decimal floating point

operations, arithmetic expression evaluation, special list-search operations, and two extensions of the translate-and-test instruction to enable a source input scanner to identify and record the presence of "interesting" characters in the source stream without stopping.

The last two chapters (totaling about 170 pages) are detailed explanations of microprogramming in the RCA Spectra 70/45 and Honeywell 4200. These systems are said to possess less generality in their ROM programmed control, i.e., in contrast to the System 360, the microprogramming is more obviously slanted to provide implementation of the Spectra's specific "machine language." Since the "machine language" of Spectra is essentially the same as that of the System 360, whose models 40 and 50 are themselves each microprogrammed in different ways, we have an in-depth view of three different microprogrammed designs which achieve the same functional result, plus a major insight into a fourth different computer.

—Kenneth P. Seidel



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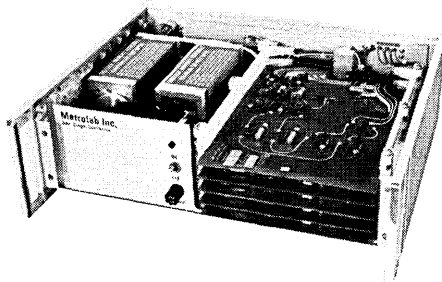
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Cassette Costs & Standards

C The question being raised about the standardization of magnetic tape cassettes for computer use as well as for data entry and communications terminals is creating some very real dilemmas in the industry. Although there is a very important place for a tape cassette transport, the question of exactly what is needed is confused. There appears to be little understanding of the realities of the market because of the usual lack of dialogue between the manufacturer and the user. What I'd like to do here is to describe the real world as I see it, and to determine what kind of cassette transports are needed to reach the market.

IBM's position with respect to digital tape cassettes is clear. They do not intend to support the Philips-type cassette which has been presented for standardization both to the American X3B1 Standards Committee and to the European ECMA. IBM has presented a new and different cassette as an alternative. The other major computer manufacturers can be expected to follow IBM. Those of us old enough to remember when Honeywell and Univac went their own way on the tape question know that the ensuing disaster is not likely to be repeated. Indeed, Honeywell indicated at an X3B1 meeting that they intend to support the IBM approach.

A second factor in the standardization dilemma is Digital Equipment Corp. DEC determines policy in the minicomputer business just as IBM determines it in the rest of the computer business.

Although DEC supplies tape transports with their equipment, they also have their own noncompatible DEC mini-tapes. They apparently intend to continue to support these DEC tapes, and they also have made it clear that

they will not support Philips-type cassettes.

But there are important reasons for using a Philips-type cassette. By understanding the place of the IBM cassette, we can see what those reasons are and what the non-IBM cassettes should do. Here are the general characteristics of the IBM cassette proposal:

- Two-reel co-planar
- 1/4" width
- Four tracks, each track serially recorded (no relation to each other)
- 1,600 bpi recording
- 3 million bytes of storage
- 7/10 inch interrecord gap
- 50 ips speed
- Peak data transfer rate of 10,000 bytes/sec.

These specifications indicate that the proposed IBM cassette transport cannot be an inexpensive device, even though there are some things one could do to lower the cost:

1. Operate at slower speed than the proposed 50 ips.
2. Read and/or write on one track instead of all four.
3. Use smaller reels of tape.

These techniques have been used in lowering the cost of tape transports. Even so, the proposed cassette transport will be more costly than is necessary if it is to be suitable for the large numbers of terminals, point-of-sale recorders, etc., that will be required in the next 10 years.

Cassette storage is generally used for:

1. Storage of data files.
2. Program storage.
3. Media interchange for data entry or output devices.
4. Intermediate storage in equipment which is either self-contained (i.e., not computer oriented) or is remote from a computer (as in communication terminals).

Of these uses, the large capacity of the IBM cassette suits it for data file storage. If it is used for data files, it can also be used for program storage or media interchange. But it is an expensive device for data entry stations or communication terminals.

The number of "remote" or "terminal" equipments is expected to be far greater than the number of central computers; such "remote" equipment is extremely sensitive to cost factors.

We can assume that the only cassette that will be accepted by the data processing industry is the IBM cassette. This cassette is NOT geared to the cost considerations of terminals, data entry devices, etc.

The solution to the cost dilemma lies in the term "remote." Many remote systems are either completely self-contained or are really REMOTE, —that is, they operate primarily via the data communications network. From this point of view, they don't have to be media-compatible with the central unit at all. For these applications, it is the data communications system that must be compatible rather than the storage medium. Thus, there is a whole set of terminal applications in which media interchange is not necessary, but low cost is very necessary.

If data entry systems are indeed to be low cost, then the added cost to the central computer for a compatible cassette input-output system should be very small even when compared to the cost of an inexpensive minicomputer. This now gives us some means

Since this article was written, Digitronics, a North American Philips' subsidiary, has announced a non-Philips-compatible cassette transport. Digitronics has in the past supported the proposed standard for Philips-type cassettes in the United States. This development appears to be an abandonment of the ECMA standard and may mean that Philips itself has seen the IBM handwriting on the wall as far as standard interchange cassettes are concerned.

The Forum . . .

for determining the cost relationship in which a non-IBM cassette becomes viable in the computer-interchange environment: The cost advantage in using the non-IBM cassette transport for all the remote equipment should be greater than the added cost to interface the cassette transport to the computer.

Such an inexpensive transport can be used if:

1. Some means of interfacing that device to the computer is provided, or
2. The communications interface is used as the input/output interface to the computer.

Consider now what the design requirements are for a low-cost, non-IBM-cassette transport.

Reliability is essential. The cost of service is too high to relax the transport reliability requirement to under 2,000 hours MTBF. The cassette must also be reliable, and must be capable of at least 2,000 passes.

Low cost is, however, equally essential. The cost of such transports (in quantities of 1,000, say) should be under \$300 including all the tape controller logic. It is only at this low cost that Philips-type cassettes provide a realistic alternative to the IBM-cassettes.

To get such a low-cost transport, some capability must be relaxed. (We have already determined that reliability is not relaxable). The best place to give up capability is in the amount of storage the cassette can hold. Application studies in the pertinent areas indicate that 50,000 to 60,000 bytes is sufficient storage. Very few terminal or data entry applications require more than 50,000 bytes. High-speed transfer is, however, important because data entry applications often require rates of 1,500 bytes/second to permit block recording within one character entry time.

Other desirable features are: read-after-write, forward/backward block detection, write interlock, and cassette-in-place interlock.

What this amounts to is a trade-off between cassette storage and very low cost. On this basis, a low-cost cassette transport could not be the proposed IBM transport. It would, however, meet most requirements, and would thus provide a needed additional capability.

—Evelyn Berezin

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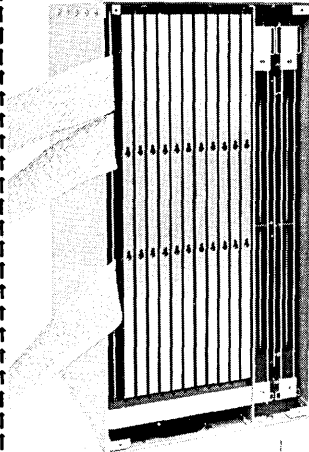
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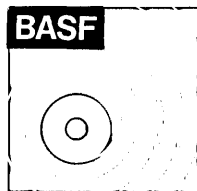
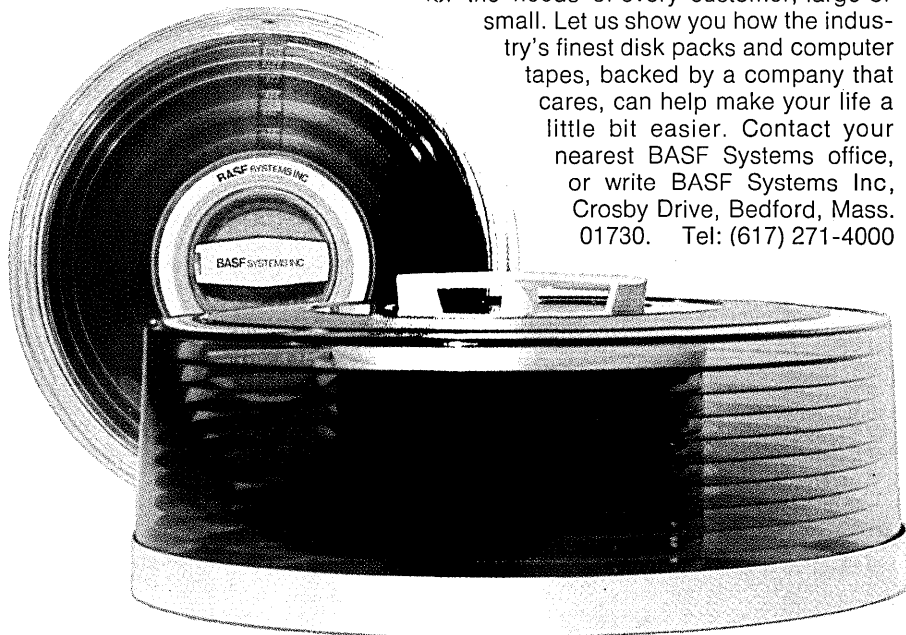
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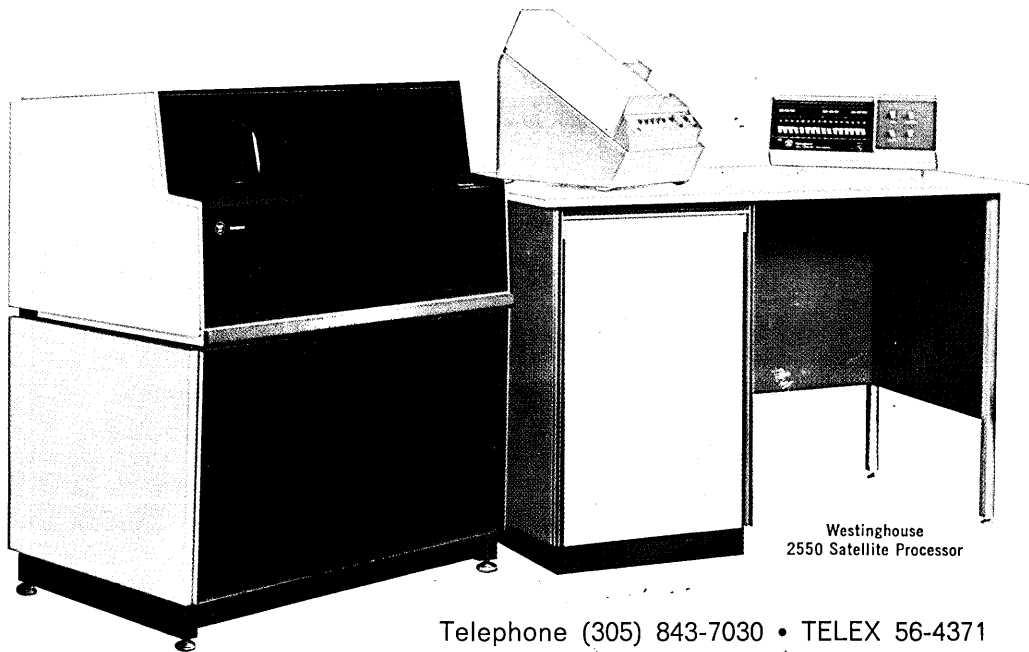
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